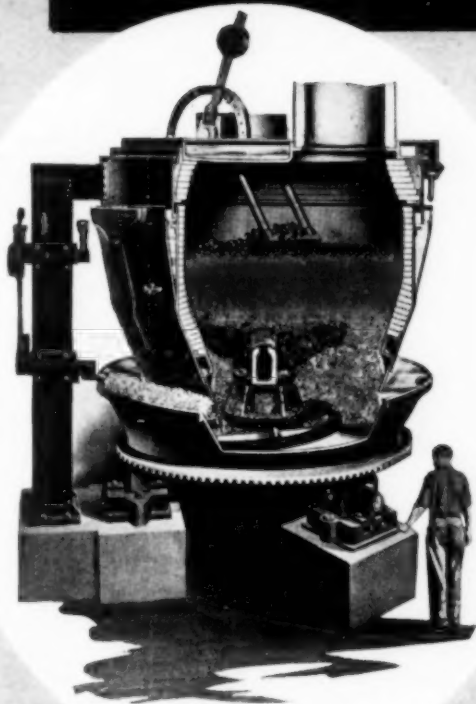
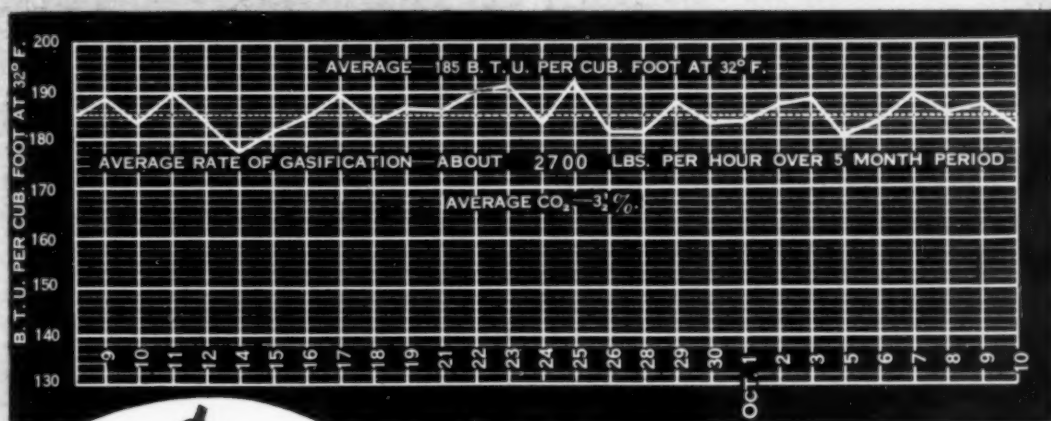


# CHEMICAL & METALLURGICAL ENGINEERING

## An Unsurpassed Record of Gas Quality

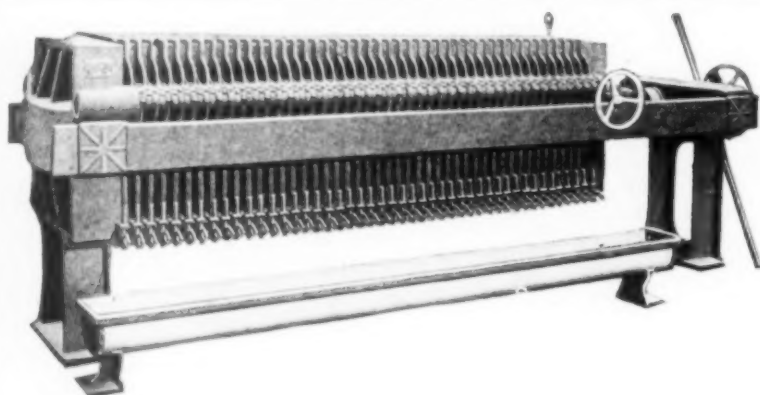
Eight-hour continuous gas samples  
from records of work's chemist at one  
of the well known steel plants in the U. S. A.



## MORGAN PRODUCER GAS MACHINES

maintain the quality  
of gas continuously  
at a high value . . .  
the operation is of mini-  
mum dependence upon  
the human element . . .  
Continuous mechanical  
feeding, leveling and  
ash discharge . . . .

**MORGAN CONSTRUCTION CO.**  
WORCESTER, MASS., U. S. A.



## Shriver Efficiency

Many years of producing filter presses for all types of filtration work enable us to guarantee the results.

This guarantee of efficiency goes with every filter press we sell—we know our product, and we are ready to stand back of it. Write for catalog stating your filtration problem.

**T. SHRIVER & CO.**

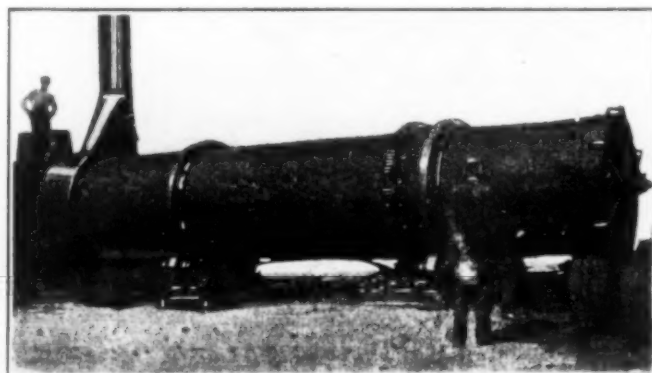
808 Hamilton Street, Harrison, N. J.

## Ruggles-Coles Steam Dryers

are built to give lasting and highly satisfactory service. They are made in three separate types and many sizes that will efficiently dry any material that must be dried at a low temperature.

Ruggles-Coles Dryers are also made for drying by means of direct heat and indirect heat. Ask for further data.

**Ruggles-Coles Engineering Co.**  
50 Church Street New York



# CHEMICAL CENTRIFUGALS



*"The Finest Extractor Made"*

That's what most engineers said at the 1920 National Chemical Exposition on seeing the

## "Hercules-Electric"

Patents Pending

Self Balancing—Bottom Discharge

Sizes 6 to 60 inch

Eastern Representative:

**F. A. TOLHURST**  
10 So. 7th St., Philadelphia, Pa.

Southern Representative:

**E. S. PLAYER**  
Greenville, S. C.

Canadian Representative:

**WHITEHEAD EMMANS, LTD.**  
285 Beaver Hall Hill, Montreal, Canada

# EAST JERSEY PIPE CO.-PATERSON.N.J.

# CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE  
Editor  
ELLWOOD HENDRICK  
Consulting Editor  
ERNEST E. THUM  
Associate Editor  
WALLACE SAVAGE  
Assistant Editor

*A consolidation of*  
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

ALAN G. WIKOFF  
R. S. McBRIDE  
CHARLES N. HULBURT  
Assistant Editors  
L. W. CHAPMAN  
Western Editor  
CHESTER H. JONES  
Industrial Editor  
J. S. NEGRU  
Managing Editor

Volume 24

New York, February 23, 1921

Number 8

## An Important Position Filled

IN THE selection of LAWRENCE WILKERSON WALLACE as executive secretary of American Engineering Council we believe that a wise choice has been made and that the purposes and objects of Council will be forwarded and accomplished promptly and efficiently. A casual survey of Mr. WALLACE's training and experience together with a knowledge of his personal characteristics and leanings lead us to believe that in him Council has a fitting team mate for Mr. HOOVER. Trained as a mechanical engineer, experienced not only in the practice of his profession but also in the instruction of those who have selected it as their life work, Mr. WALLACE brings to the secretaryship those precise habits of thought and action which mark the engineering executive. But more than this, he brings a genuine sympathetic interest in the human element in industry which gives him a point of view particularly needed in Council's first great work—a survey of industrial wastes. His address on Conservation of Labor, at the meeting of Council in Washington last fall, was one of the high lights of the convention. His broad interest in engineering is indicated by the fact that he has been three times chosen president of the Society of Industrial Engineers.

Mr. WALLACE has been elected to one of the most important and exacting positions in engineering societies, but we feel confident that he will be found active and capable and that American Engineering Council will be able to point to a definite record of achievement under his secretaryship.

## Inadequate Support of Foreign Trade Representatives

THE United States today is practically in the position of a business man with many bills receivable who declines to provide collectors to go out and arrange for the settlement of the obligations due him. Foreign nations owe the United States several billion dollars, an important fact which we can all well appreciate when we come to pay our income taxes. The most promising method of securing return for these loans is through the channels of international trade, both with the nations to which the loans were made and with others which are indirectly able to facilitate payment of the loans. The foreign representatives of this Government who are required as one link in our business chain are the foreign trade representatives in the Bureau of Foreign and Domestic Commerce and in the consular service of the State Department. It is of great importance, therefore, that American indus-

try consider how these representatives of American business are to be provided for during the coming year.

According to the House of Representatives' proposals the Bureau of Foreign and Domestic Commerce will have approximately \$900,000 to conduct its affairs during the next fiscal year, an amount equal to less than one-fiftieth of one per cent of the total Government expenditures. This is only 60 per cent of the minimum sum which the Secretary of Commerce believes to be necessary for effective conduct of trade matters. Fortunately the Senate Committee on Appropriations was a little more generously disposed and suggested an increase of \$50,000 in these funds. Certainly it is to be hoped that the larger amount will be provided, though even it is far too small for full attention to this important foreign trade activity.

The Consular Service and the other branches of the State Department dealing with trade matters were provided for most inadequately in the House of Representatives. The appropriation suggested for them was nearly a million dollars less than during the present year. The Senate, however, again comes to the rescue and has by committee action increased the provision for this service to a more nearly adequate sum. In conference this difference between the two houses of Congress will have to be adjusted and here again the far-seeing business men of the country will certainly wish that the larger appropriation be granted, even though it may seem to be an increase in the burden of taxation. As a matter of fact, it is the most far-seeing investment in foreign trade which our Congress can provide.

In dealing with all these matters one must remember that the transfer of money for the payment of international indebtedness is now, even more than formerly, a matter of practical impossibility. Our debtors can repay us only with raw materials or manufactured goods. If we keep in touch with their markets and production conditions we can most effectively learn what and where to buy as well as what and where to sell.

Those nations to which we sell largely will generally be those that are not indebted to us, but rather those from which we draw many of our most important raw materials. Cultivation of friendship and active trade relation with them obviously is as much an advantage as with those from which we desire to secure something in compensation for funds previously loaned. In other words, no matter what nation we consider, it is worth while to have adequate commercial investigators and consular representatives on foreign ground for the advice of American industry.

## Iron and Steel Production Costs

**A**LREADY not a few iron and steel manufacturers have begun to express regret at the course the iron and steel market was permitted to pursue in 1920, when prices advanced sharply partly through competitive bidding by consumers, particularly automobile and parts makers, and partly through producers definitely seeking the highest obtainable prices.

It is being found now that the net results of operations at high prices were not as satisfactory as they appeared to be at the time. There are two chief flaws, one being that the manufacturers do not today find themselves in possession of all the profits they thought they were making, the other being that they do find themselves with very high production costs.

With many manufacturers it was a case of "come easy, go easy." There was no difficulty in obtaining high prices, for buyers came to the plants and bid advanced prices to secure material, but when the pressure was for material and receipts were large altogether unbusinesslike expedients were resorted to with the object of maintaining or increasing production. While the customers of independent steel mills were competing with one another to get steel, for instance, some of the steel makers were competing with one another to get Connellsville coke, with the result that for weeks the market for spot Connellsville coke averaged about \$18 per net ton at ovens, when in May, 1915, the same coke, only much better quality, had sold at \$1.50. Labor was scarce and knew it, so bonuses were paid and men were practically bribed to stay on the payroll.

During the period of inflated prices in steel there was criticism of the mills in some quarters on the ground that the market was "riding for a fall." The probability is that the manufacturers realized that a break was going to come, but reasoned that a break would occur in any event and would be no more damaging if from one height than if from another. That seemed to be fairly good logic had it not been for the constantly mounting costs.

In striking contrast with the course of the independents in 1920 was the course of the United States Steel Corporation, which kept its prices at the Industrial Board schedule of March 21, 1919, and refrained from attempting to swell its production by unusual or competitive methods. The corporation was very short of coke, but made no effort to buy in the open market. It could not furnish all the steel its customers desired, but it refused to let them bid against one another. Thus the corporation has built up its good will. The corporation has high costs, relative to those in the past, but it has not a great deal to liquidate except by a general wage reduction, which will eventually be made.

A difficulty confronting the independent steel producers at this time is that while they are anxious to reduce their costs and get down to a really economical basis it is impossible to reduce costs when there is no operation. At the moment there is not enough business to be had to operate upon, except in a way that would make no real showing as to costs.

The task before the steel industry is, however, a stupendous one. In the years just before the war there was question whether the productive capacity was not somewhat greater than was really needed, for the spells of light operation had been almost as long as the spells

of full operation. There was no calendar year of full operation throughout, after 1906, until the war demand produced full operation in 1916. Nevertheless pig iron capacity is 35 to 40 per cent greater than in 1914 and steel making capacity about 50 per cent greater. It is necessary therefore to produce with the greatest possible economy in order to build up a demand that will employ the capacity.

## Decentralization in Technical Societies

**I**N HIS address last week as retiring president of the American Institute of Mining and Metallurgical Engineers Mr. HOOVER reviewed the Institute's important activities during the year 1920. Among the most important of these he regarded the trend toward decentralization as offering the greatest promise for the welfare and influence of the Institute as a whole. The increase in the number of local sections and their growth as important factors in the life of the Institute he regarded as one of the outstanding achievements of his administration and he commended to his successor in office the adoption of a policy that would foster this tendency.

It is worth recording here that the Mining Engineers are not alone in this decided drift toward enhancing the importance of the local section and decentralizing Institute activities. The other great national engineering societies have been showing this drift in more or less marked degree. The Mechanical Engineers have for some time past recognized the importance of fostering local sections and encouraging them to greater activity and participation in society affairs. The Electrical Engineers also, we believe, have a form of government which results in as much decentralization as is consistent with the conduct of the Institute's business at headquarters. The recent complete change in régime in the Civil Engineers was the consequence of dissatisfaction with highly centralized authority, and a determination to recognize the increasing importance of local sections. And finally it may be noted that the administration of the newly organized Federated American Engineering Societies is convinced that this great body can function to best advantage through the activities of state sections or groups.

Apparently enlightened opinion on the conduct of technical societies has recognized the evils of a highly centralized organization, with its tendency to dominate affairs through a self-perpetuated clique that fears to let the membership get out of hand through too great local activity. It is, of course, recognized that in all national societies there must be enough officers and directors living near headquarters to insure the transaction of regular business, but beyond that there should be no attempt to limit or control the activities of the membership through fear that the local section might grow in power and menace the solidarity of the parent organization. Rather should local sections be encouraged to increase their strength and influence by joining with other local, state and regional societies for participation in local public affairs. Affiliation with Chambers of Commerce and co-operation with representatives of the local government will be found to be fruitful fields of endeavor. From these activities the local bodies will acquire a lively sense of importance, to which the prestige of their national organizations will make a further contribution. With a number of

such flourishing local organizations receiving encouragement and support from headquarters the reaction on the parent organization can have but a beneficial and desirable effect. The day is past when a local section of any national technical society can be a nonentity without contributing toward centralization of authority and rule by clique.

### Improvement In Drill Steels

IT APPEARS from figures presented by B. F. TILLSON before the recent meeting of the American Institute of Mining and Metallurgical Engineers that a perfectly amazing number of breakages in drill steel is accepted as a matter of course by men in charge of rock-drilling operations. Mechanical sharpeners, drilling machines and details of drill bit and shank have been perfected with infinite care, yet one out of every hundred pieces of drill steel tightened in a chuck breaks short across in the shaft before becoming dull. Records for heavy drills have shown a loss from breakage as high as 7 per cent per shift. This involves a waste which is surely worthy of attention.

Disregarding the influence of rough handling underground, and improper operation of the drilling machine, which are evidently matters for the attention of the mining men, the responsibility for this great mortality in drill steel may rest primarily in the stresses imposed in service, in the composition or constitution of the steel itself, or in its heat-treatment during and after forging the shank or bit ("sharpening").

Drill breakage is mostly confined to the shaft of the drill itself. If a portion of the bit flakes off, the drill is ordinarily classed as "dull," and is reformed. Transverse breaks in the drill rod itself, which are the cause of the present inquiry, are often ascribed to the progressive extension of "fatigue checks," such fractures having been induced in test runs after 50,000 impacts. However, it is difficult to see how so few alternations could cause the damage in view of Prof. MOORE's work at Urbana showing that 100 million alternations at the elastic limit were insufficient to rupture either ingot iron or normalized eutectoid steel, unless the beating of the drill bit against the rock is so timed with the vibrations along the drill shaft as to build up standing waves of high amplitude, or unless the steel is dirty or highly segregated. Hot spots along the length of a drill when in use are ascribed to such stress waves, and their importance was experimentally shown by Dr. BURROWS. Since records at the New Jersey Zinc Co. undoubtedly showed that if a broken drill be resharpened, a second break will occur after a shorter time in service than the first, and a still shorter time after each succeeding repair, Mr. TILLSON argued that fatigue was responsible, but the same facts would result from the cumulative damage done by successive improper forgings and heat-treatments.

But the steel itself may be faulty. The work it must do is most severe. It is continually in the hands of workmen of more brawn than brains throughout its journey from steel plant as drill rod back to the steel plant as scrap. Perhaps it is unfair to expect one rod of uniform composition to be able to be so hard at its point that it will bite into granite, and yet tough enough along the shaft to transmit the impact of heavy driving piston, and at the same time withstand occasional sledge blows from sweating miners.

Many of the breaks exhibit the detail fracture characteristic of transverse fissures in rails, about which so much has been said and so little is known. If these fractures can be readily induced in drill rods, their study may easily throw a great deal of light on sound steel for rails. Undoubtedly segregation at the nucleus has much to do with starting these failures. Segregation occurs every time a steel ingot solidifies and will to the end of time. Some of it can be later removed by correct heat-treatment, but solid non-metallic inclusions—a perfectly normal constituent of steel—remain more or less unaffected. A thorough research into drill steel will have to determine what sonims are harmful and what sonims are harmless.

Those who have watched the mine blacksmith at work, or even observed the elaborate drill-sharpening plant of the Calumet & Hecla company, controlled as it is by the human eye pyrometer, are not surprised at Mr. FOLEY's analysis showing by far the largest proportion of breakages to occur near ends—where the cold steel rod was heated preparatory to forging, but where it received no working; where it acquired a coarsely crystalline structure and was cooled slowly, receiving no subsequent grain refinement. Undoubtedly these failures were due to faulty heat-treatment, yet if education of the smiths can progress so that the more glaring abuses are prevented it is difficult to see how the remaining failures can be improved short of a complex heat-treatment of the end, or a more simple heat-treatment of the entire rod, either of which is beyond the skill and resources of any but the largest and most progressive mining companies.

Meanwhile cannot metallurgists offer a different kind of steel which is more nearly fool-proof than the plain high-carbon hollow hexagons now so largely bought and broken? An indication that the composition is not beyond improvement is the fact that rods made up of electrically butt welded pieces very seldom break at the welds, where undoubtedly a considerable amount of decarbonized metal exists. If a carburized bit and decarburized shaft is impracticable, cannot alloy steels be substituted for the carbon steels, admittedly less responsive and more "tricky" or tender under heat-treatment than many more complex compositions? It is known that the steel which acquires the full measure of its possibilities after the fewest and least drastic heat-treatments is of such a nature that the transformation starts at locations which are packed closest together. It is also known that a steel exhibiting high thermal hysteresis will acquire similar physical properties despite rather large variations in the quenching and annealing temperatures. Many alloy steels have closely packed crystallization and transformation centers and at the same time a considerable temperature interval between the critical points. Have these steels not been exploited? is the price too high? or are mining men too timid to attempt reforming the blacksmith shop?

Whatever the answer to these queries, we welcome the co-operative investigation of drill steel. The questions raised by a preliminary survey of the problem by mining engineers (not metallurgists) are precisely those which are fundamental to the modern science of physical metallurgy. If investigators in pure science needed justification, they could point to this new inquiry of a distinctly "practical" nature to prove the commercial utility of a study into Fe:C:O equilibrium, the chemical composition of emulsified inclusions, or atomic configuration in metallic crystals.

## Notes on French Industries

FROM OUR PARIS CORRESPONDENT

PARIS, Jan. 15, 1921.

THE condition of the French chemical and metallurgical industries at the beginning of 1921 is far from satisfactory. Plants erected during and subsequent to the war have enjoyed a short period of prosperity, but now that German products are again on the French market the competition with home products is strong and greatly in favor of the Germans. The young industries did not develop the vitality necessary to enable them to meet with immunity the present economic difficulties.

### STATUS OF THE CHEMICAL INDUSTRIES

The crisis is most pronounced in the synthetic dye industry. During the last few years France made great efforts to develop this industry to a point where she could make 765 metric tons per month (August, 1920), but at present the production is steadily declining, as shown by the figures for September and October—640 and 625 tons respectively. The official figures for the last two months of 1920 undoubtedly will show an even more marked decline. The total production of dyes is hardly sufficient to supply 50 per cent of the total French consumption, which is now about 12,000 tons per year.

During 1920 the Germans supplied 2,255 tons at a cost of 32 million marks, of which 1,275 tons, valued at 19.5 million marks was delivered between May and the end of December, 1920.

The present French tariff on dye importations is of practically no help to the French industry because the import duty is negligible when it is considered that the price of dyes has increased up to tenfold and more.

One of the few successful new chemical companies, the Société Alsacienne de Produits Chimiques, which is in reality the successor to the Société de Produits Chimiques de Thann et Mulhouse, has increased its capital from 16 to 30 million francs and has consolidated with the Société des Produits Chimiques de La Rochelle. The company is now erecting a synthetic camphor plant at La Rochelle. It is worth mentioning that the erection of this plant was decided upon when camphor sold at 85 f. per kg. and that now camphor is quoted at 40 f. per kg. The officials of the company state, however, that the drop in price will not affect them, as they have contracts for the sale of their total production at the former price, and that in addition the cost of the principal raw material (essence of turpentine) has dropped from 1,000 f. to 580 f. per 100 kg.

### THE STATUS OF THE METALLURGICAL INDUSTRY

The most optimistic comment that can be made concerning the French metallurgical industries is that better days are expected in the near future. The government hopes to have helped the iron industry somewhat by fixing the price of blast-furnace coke at 135 f. per ton beginning Jan. 1, 1921, which means an abrupt reduction of 40 f. per ton, the price for coke used in all other industries being fixed at 200 f. per ton.

The metallurgical industries of Lorraine suffer the most due to the fact that the sale of the Lorraine plants to French firms after peace was declared took place under very abnormal conditions. The buyers' bids were not based on the actual value of the production capacity of the plants but on the desire to acquire them at any price. The result is that there are now in Lorraine a

number of overcapitalized enterprises of a producing capacity far over the present market demands and which are forced continuously to lower the selling price of their products to meet their most pressing financial needs. The consequence of this abnormal situation is that a number of Lorraine plants and practically all the plants in the Department of Meurthe and Moselle are shut down, a condition without precedent in the history of the French metallurgical industry. It is stated that the producers in the above two departments have about 200,000 tons of pig iron in stock and are anxiously waiting for buyers. What makes the condition even worse is the strong competition of the Germans who take advantage of the abnormal exchange rate of the mark and who again make efficient use of their former dumping policy.

### SOYA OIL COMPETING WITH ARACHIS OIL IN THE SOAP INDUSTRY

The Marseilles soap industry is now using great quantities of hardened arachis oil (peanut oil) supplied exclusively by England. The advantages of using the hardened product are an economy of 35 per cent over the use of industrial arachis oil and a harder soap. Encouraged by these results, the Marseilles manufacturers, wishing to become independent of the English supply of this important product, are trying to induce the French producers of arachis oil in West Africa to install their own plants for the hardening of the oil. The hardened oil now sells in Marseilles at 360 f. per 100 kg. The use of soya oil gives results similar to those obtained with hardened arachis oil and Japan is now trying to introduce the use of soya oil by offering it at 340 f. per 100 kg. A strong competition is now going on as to which product shall prevail in the soap industry.

### PROGRESS OF THE FRENCH POWDER AND EXPLOSIVES INDUSTRIES

Prof. Haller has recently presented two papers before the Société d'Encouragement pour l'Industrie Nationale de France on the work of French chemists in the powder and explosives industries during the war. The following few figures he mentioned may give an idea of the rapid progress realized.

B-powder (nitrocellulose). The production in August, 1914, was 14 tons per day; in 1917 it reached 367 tons per day.

Nitrated Explosives. The production in August, 1914, was 8 to 9 tons per day; in July, 1917, it reached 700 tons per day.

In 1917 France produced 175 tons per day of chlorated explosives, which were used mostly in the preparation of grenades.

### American Chamber of Commerce in France

At the annual meeting of the American Chamber of Commerce in France held in Paris, Jan. 17, 1921, A. M. Thackara, American Consul-General in Paris, spoke on France's export to the United States during 1920. The grand total value of the French export to continental United States and its possessions amounted to \$467,158,848, as compared with \$168,146,032 in 1919.

There are now 978 members, as against 800 in 1919 and 473 in 1918. The officers for 1921 are: Walter V. R. Berry, president; Charles E. Carpenter and A. D. Veil, vice-presidents; W. Morgan Day, treasurer, and V. K. Stevenson, honorary secretary.

## American Institute of Mining and Metallurgical Engineers

Abstracts of Papers Presented Before the Winter Meeting, With Notes on the Technical Discussions—  
Notable Sessions on Ferrous and Non-Ferrous Metallurgy, Including an Excellent Symposium on  
Breakage and Heat-Treatment of Drill Steel

NEW YORK entertained, in the usual manner, the winter meeting of the American Institute of Mining and Metallurgical Engineers, Feb. 14 to 17. Fifty or more papers were presented at fourteen technical sessions, many excellent ones being read from author's manuscript, owing to the fact that the Institute's funds are apparently not large enough to cover the cost of pre-printing them. This results in perhaps more attention to the paper on the part of the members present at the technical sessions, but prevents the attention and profit of the nine thousand or more less fortunate members. Furthermore, some of the metallurgical papers were held over from the Lake Superior meeting, possibly for geographical reasons. Two long sessions, under the able chairmanship of B. F. Tillson, presented a symposium on failures in drill steel, reference to which is made editorially in this issue.

Physical conditions surrounding the meeting were rather better than the average. Programs were carried through promptly and without delays, entertainment features on the whole were quite good, and were enjoyed by members of all ages and their guests. The Institute will perhaps never again be so fortunate as to have Herbert Hoover for president and E. P. Mathewson for host at the same meeting. Edwin Ludlow, the new president, assumed the duties of his office at the closing banquet.

### Non-Ferrous Metallurgy

A. B. Young, superintendent of the Tooele Plant, International Smelting Co., described the flue-type treater handling the company's roaster gases, an installation whose details have already been given in *CHEMICAL & METALLURGICAL ENGINEERING* for Dec. 29, 1920, vol. 23, p. 1244. It excited favorable comment as to its economy in first cost and operating charges. It is there used primarily to catch true dust. A. A. Heimrod cited two other installations of this type, of the same size, one precipitating dust whereas the other cleared fume. The latter required about four times the power input.

#### ELECTROLYTIC ZINC

The paper by Frederick Laist and his associates on Anaconda's Electrolytic Zinc Plant has already been reviewed at length in the columns of this journal (Feb. 9, 1921, vol. 24, p. 245), but the original paper, with its enormous amount of data, should be in the hands of all men interested in this phase of metallurgy. Discussion brought out a very interesting contrast in views. S. C. Bullock, writing from England, emphasized the need of extreme purity in tank solutions, while W. C. Smith described informally the process in operation at Martinez, Cal., developed by Messrs. Tainton and Pring. Using Australasian ore, Mr. Bullock finds that a most elaborate purification cycle is necessary. Nickel and cobalt especially must

be eliminated to less than 0.0001 per cent—in fact nickel was ordinarily kept about 0.00002 per cent; such special efforts were found to pay in a gratifying increase in tank efficiency. Hand-rabbed furnaces were favored in Great Britain. Conversion of 97 per cent zinc to soluble form was not rare, while 90 per cent soluble was regarded as merely fair practice on very difficult Australian ore. Iron was ordinarily removed after filtration; it was removed by aëration and  $\text{CaCO}_3$ .

At Martinez the calcines are ordinarily separated magnetically into two portions. The first, or magnetic (iron), portion leached with hot strong acid—27 per cent  $\text{H}_2\text{SO}_4$ —the spent cell solution. When the free acid has been reduced about one-half, further neutralization is effected by the second or oxidized portion of the calcine. The resulting solution contains as high as 200 g. Zn per liter, and of course must be filtered hot. The purification cycle is relatively simple, but is effected by an unrevealed method; the purification, however, is not nearly as high as otherwise. Cobalt or arsenic can run as high as 30 mg. per liter; antimony, however, is much more troublesome. Clear solution is added to the circulation to keep the heads at about 70 g. Zn per liter. It is electrolyzed until about 30 g. remain, using a very high current density—100 amp. per sq.ft. Electrode spacing is 1½-in. face to face; voltage is about 4 volts per cell. It is evidently necessary to refrigerate the electrolyte to keep down the  $I^2R$  heating. Much glue is used in the cells; about 3 lb. is consumed for every ton of zinc produced. This keeps down the acid mist effectively; indeed the undue formation of mist is an indicator of the need of more colloid. Current efficiency averages 89 per cent of the theoretical electrochemical equivalent of zinc, with an input of 1.77 kw.-hr. per lb. of zinc. The 35-hr. cathode deposits are very dense and smooth, showing no signs of sprouting despite their thickness of ⅜ in. Average extraction from a 39 per cent ore averaged 87.6 per cent for a fortnight's operations, figured on the weight of cathode sheets, about two tons of which are produced daily in the present plant.

The chairman, E. P. Mathewson, characterized the work of Tainton and Pring as being the final evidence that furnace methods for zinc production are doomed to extinction. Their experiments show that a small plant can be erected having a very large output, and only where natural gas is extraordinarily cheap and electricity extraordinarily dear can retort smelting show advantages in cost per pound of zinc.

#### STEEL CHIMNEYS IN COPPER PLANTS

"Steel Chimneys and Their Linings in Copper Smelting Plants" was the title of a paper by A. G. McGregor, in which he gave the structural details of a number of such erected in the Southwest, and a

record of their performance. From the data he concluded that unlined steel chimneys or chimneys or dust chambers lined with building tile have not given satisfactory service when used for roaster or reverberatory furnaces, but they have endured for long periods when used for blast-furnace and converter gases. Such results may be expected in ordinary copper plants where no especial effort is made to keep gases at a high temperature. Table I summarizes his data.

Unfortunately no explanation of the corrosion was ventured. Converter gases usually corrode metal flues badly, but Hiram Hixon advanced the opinion

### Non-Ferrous Metallography

W. P. Sykes presented a paper on the "Effect of Temperature, Grain Size and Rate of Loading on the Mechanical Properties of Metals." This is a companion paper to one of the same title by Dr. Zay Jeffries,<sup>1</sup> appearing in the *Transactions* of the Institute for 1919 (vol. 60, p. 474), the two men working in conjunction in both researches. There are now two series of metals, W, Fe, Cu and Mo, Ni, Al, which have been carefully studied and the results are available to verify existing generalizations between atomic configuration and various

TABLE I. STEEL SMELTER STACKS

Plant	Location	Date of Erection	Kind of Gases	Diameter of Shell	Height of Stack	Lining		Material	Present Condition of Stack
						Height	Thickness		
Calumet & Arizona.....	Douglas	1913	Roaster	20 ft. 7½ in.	279 ft.	40 ft. 239 ft.	4½ in. 4 in.	Common brick Building Tile	Rebuilt in 1918
Calumet & Arizona.....	Douglas	1913	Blast furnace and reverberatory	25 ft. 9½ in.	305 ft.	305	4 in.	Building tile	Excellent
Calumet & Arizona.....	Douglas	1906	Blast furnace, converter since 1913	15 ft.	200 ft.	85	6 in.	None	Excellent
Cananea Consolidated...	Cananea	1903	Blast furnace	19 ft. 9 in.	170 ft.	85	4½ in.	Radial block	Excellent
Cananea Consolidated...	Cananea	1902	Reverberatory	12 ft.	171 ft.	85	9½ in.	Radial block	Excellent
						86	4½ in.	Fire brick	Lining renewed in 1910; upper 75 ft. rebuilt in 1917
United Verde.....	Clarkdale	1915	All departments	30 ft. 9½ in.	400 ft.	400 ft.	4½ in.	Brick	Excellent
International Smelting Co.	Miami	1915	Converter	15 ft.	200 ft.	15 ft.	200 ft.	None	Excellent
International Smelting Co.	Miami	1915	Reverberatory	22 ft.	300 ft.	100 ft.	4 in.	Building tile	Replaced by brick stack in 1921
Detroit Copper Co.....	Morenci	1899	Converter and blast furnace	13 ft.	165 ft.	....	....	None	Bad corrosion in upper 12 ft. during shut downs.
Copper Queen.....	Douglas	1904	Converter and blast furnace	25 ft.	260 ft.	....	....	None	Excellent
Old Dominion.....	Globe	1904	Converter and blast furnace	14 ft.	200 ft.	....	....	None	Excellent

that this was caused by eddy currents between the hot gas and cold air drawn into the hood, producing a zone locally cooled below the dew point, with a resulting precipitation of acid. Further along, where the gas and entrained air had a chance to become thoroughly mixed and equalized in temperature, little precipitation occurred, with correspondingly small corrosion. His observations from Mexico and Canada convinced him that corrosion of metallic smoke ducts was a matter of humidity—keep the temperature above the dew point within the flue or chimney, and corrosion will occur only at the exit, where the out-flowing gas strikes a very wet or very cold atmosphere.

Forest Rutherford also agreed that the temperature of sulphurous gases should be relatively high if corrosion was to be prevented. During his superintendency at Copper Queen, the main stack—200 ft. high and unlined—venting the smoke from all departments, was kept hot continually. Even when the smelter was shut down a good fire was maintained at the base. This stack is still undamaged. Building tile and lime mortar are to be avoided because of the formation of gypsum with a large increase in volume—thus breaking up the continuity of the material. Roaster and reverberatory gases are different in their nature and corrosive action for many causes, not least of which is the moisture content of the furnace feed.

C. R. Kuzell also pointed out a controlling factor existing at the Clarkdale smelter, where a 30 x 400-ft. brick-lined steel stack discharges smoke from all departments. The ores contain some zinc, and enough of it is fumed during operations to neutralize acidity in the hot gases. Lacking available base of this sort, definite steps would doubtless be necessary to prevent corrosion.

easily observable physical properties. Of these six metals, X-ray investigations indicate that W, Fe and Mo crystallize in the body centered cube. Cu, Ni and Al, together with Pb, Pt, Au and Ag, assume the face centered cubic structure, and when equiaxed hold their ductility to the temperature of liquid air, as does also manganese steel. Here is a little light on the difference between gamma and alpha iron. Manganese steel, which is austenitic, shows a face centered cube under X-ray analysis. Consequently gamma iron is also thought to be of this crystallinity, whereas alpha iron, as above stated, is body centered. In common with tungsten and molybdenum, it is brittle instead of somewhat ductile in liquid air. Magnesium and zinc harden very rapidly under cold deformation, and appear to belong to the hexagonal system. In general, it may also be said that the rate of change in physical properties as the temperature varies is a function of the atomic weight—i.e., a change of say 100 deg. C. will make a greater change in the elongation of tungsten or lead than it will in the elongation of iron or aluminum.

### ARTILLERY CARTRIDGE CASES

"Artillery Cartridge Cases" were discussed by J. Burns Read and S. Tour. They pointed out that since these cases are cold-worked from brass disks, it is essential first that the original disk be of good quality; second, that the tools and amount of cold work be correct, and third, the annealing heats between successive stamping or drawing operations be carefully controlled. Formerly only a rather loose chemical specification had to be met, pending final acceptance of the lot by ballistic testing. In the latter, three cases from each lot are fired at 12 per cent excess powder charge.

<sup>1</sup>CHEM. & MET. ENG., vol. 20, p. 211 (March 1, 1919).

During the war no lots were rejected at this point, although 123 had to be retested, 72 of which were due to deficiencies in metallic structure and could have been predicted from the records of the metallurgical tests made by the government inspectors.

Physical tests on strips taken from two cases in each lot were utilized principally for the guidance of the manufacturer; good results were ordinarily obtained except at the end of the case, where varied amount of work and consequent error in the reheating temperature caused deviations. These tests have now been well established, and pending the development and general acceptance of a substitute in the form of a hardness test, should be put into the specifications as a requirement.

Microscopic observations on six locations in five cases from each lot proved of extreme importance in the control of correct manufacture. In general, typical micro-sections showed a well-defined re-crystallization at the mouth, hard metal in the wall behind the taper, and well-worked metal in the end.

Mercuric chloride tests on one case were also made for manufacturing control. As is well known, immersion for four hours in a 1½ per cent solution will develop intercrystalline cracks in metal where somewhat severe differential stresses produced by incorrect working or annealing exist, especially if they are tension stresses, and which later would result in those spontaneous and mysterious failures known as season cracking. No connection has been discovered between this test and the others, and whereas it caused many rejections from immature contractors, the difficulties could ordinarily be removed by giving close attention to the tool design, by increasing the work at the last redraw, and by increasing either the time or the temperature of the final anneal.

### Session on Metallography of Iron and Steel

"Nitrogen in Steel, and the Erosion of Guns," by H. E. Wheeler, was printed for the Lake Superior meeting of last August, and abstracted in our issue for Sept. 1, 1920 (vol. 23, p. 366), as was also another interesting metallographical paper by Messrs. Hemingway and Ensminger on "Surface Changes in Carbon Steel Heated in Vacuo." Mr. Wheeler's work was on the cause of explosive rupture of gas containers, but in the course of the investigation he noted many similarities to surface conditions in gun tubes. Hardening and embrittling by nitrogen have been recently discussed in these columns by Knight and Northrup<sup>2</sup> and Fay.<sup>3</sup> One statement made by Mr. Wheeler, that "iron nitride is no more metallic than iron oxide, and the writer seriously questions its ever having been found as a metallographic constituent of steel," was taken sharp exception to by both W. R. Ruder and George F. Comstock. These men, together with S. W. Miller, have shown that some nitrogen-bearing constituent is undoubtedly present in fusion welds. This may not be iron nitride, but it is quite distinctive and has been observed in carbon-free iron and steels up to 0.20 carbon, therefore it is not associated with a critical carbon content. Using the word "nitride" to signify this new constituent, it is known that pearlite and nitride cannot be distinguished by HNO<sub>3</sub> or picric acid etching. Ruder

and Comstock have had good results with a modified Stead's reagent,<sup>4</sup> but the Bureau of Standards was not so successful in its use, since massive nitride is sometimes unattacked. Comstock now reports that a boiling reagent consisting of 10 g. KOH, 1 to 4 g. potassium ferricyanide, in 100 c.c. water, if applied from ten to thirty minutes will give a sharp distinction. Massive cementite is blackened, massive nitride is attacked only slightly, becoming yellowish in tone, while pearlite is etched at an intermediate rate, assuming a distinctly brown tint.

### Reaction Between Iron, Carbon and Oxygen

A. Matsubara, of the University of Kyoto, Japan, has made some fundamental studies in the "Chemical Equilibrium Between Iron, Carbon and Oxygen."

The long and painstaking work may be reviewed under several heads:

(1) In properly constructed and operated apparatus, the equilibrium compositions of the gases CO and CO<sub>2</sub> in contact with metallic iron and ferric oxide were carefully measured at 863, 1,070 and 1,175 deg. C. Over 100 separate tests were made in this one study. The net results show that the following percentages of CO are in equilibrium with the following substances at the temperatures stated:

	863 Degrees C.	1,070 Degrees C.	1,175 Degrees C.
Fe <sub>2</sub> O <sub>3</sub> .....	0	0	0
Fe <sub>3</sub> O <sub>4</sub> .....	25	15	15
FeO.....	67	72	75

The first line means simply that at the temperatures used, Fe<sub>2</sub>O<sub>3</sub> dissociates of itself into Fe<sub>3</sub>O<sub>4</sub> and O so strongly that any CO present is oxidized to CO<sub>2</sub> and no equilibrium exists; or, putting it another way, any percentage of CO will reduce Fe<sub>2</sub>O<sub>3</sub> to Fe<sub>3</sub>O<sub>4</sub> at any of these temperatures.

The second line means that Fe<sub>3</sub>O<sub>4</sub> is reduced to FeO by any mixture containing more than the percentages of CO given, at the temperatures named.

The third line indicates that FeO is reduced to Fe by any mixture richer in CO than the percentages given.

In each case, the percentage of CO means the proportion it forms to the sum of CO and CO<sub>2</sub> present, ignoring the inert nitrogen which may accompany it in the blast or other furnace. Diagrams are given which summarize the various tests.

(2) From these data, the author has calculated Tables

TABLE I. VALUES FOR FeO-Fe EQUILIBRIUM

Temperature Degrees Absolute	Per Cent CO	(Equilibrium Constant) Log K	Log P	P%
834	0.536	8.2530-10	8.4618-10	0.029
935	0.584	9.4400-10	9.5263-10	0.336
993	0.607	0.0181	0.0461	1.112
1,136	0.659	1.2085	1.1035	12.7
1,236	0.692	1.8914	1.6997	50.1
1,343	0.724	2.5218	2.2432	175.0
1,448	0.755	3.0618	2.6999	501.0

I and II, giving the gas pressures exerted at different temperatures by FeO and Fe<sub>3</sub>O<sub>4</sub>, respectively, in presence of C as a reducing agent.

It must be remembered that in the blast furnace these are in reality partial pressures, being that fraction of the total tension of the gases borne by the CO and CO<sub>2</sub> present. The author further calculates the simple

<sup>2</sup>"Some Notes on the Effect of Nitrogen on Steel," vol. 23, p. 1107 (Dec. 8, 1920).

<sup>3</sup>"Nitrogen and Case-Hardening," vol. 24, p. 289 (Feb. 16, 1921).

<sup>4</sup>Consisting of 0.1 g. mercuric chloride, 0.1 cupric chloride, 20 c.c. concentrated HCl and 80 c.c. ethyl alcohol. This is dropped on the sample, and the pearlite rebrightened by gentle polishing, repeating the process until a satisfactory contrast is had.

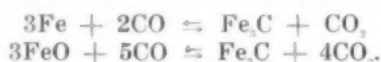
TABLE II. VALUES FOR  $\text{Fe}_3\text{O}_4\text{:FeO}$  EQUILIBRIUM

Temperature Degrees T Absolute	Per Cent CO	(Equilibrium Constant) Log K	Log P	F*
900	0.435	9.0574-10	9.5325-10	0.341
993	0.352	0.0181	0.7366	5.453
1,136	0.255	1.2085	2.3763	236.8
1,236	0.204	1.8914	3.1730	1,489.0
1,343	0.164	2.5218	4.0143	10,335.0
1,448	0.152	3.0618	4.6265	42,320.0

\* These values of P represent the total equilibrium pressure of the system containing amorphous carbon.

dissociation pressures of the compounds  $\text{Fe}_3\text{O}_4$  and  $\text{FeO}$ , at temperatures from 800 to 2,400 deg. absolute. These data are of great scientific interest, but do not apply directly to blast-furnace practice, where C is always present.

(3) The reactions by which iron absorbs carbon and becomes carburized are next studied. They involve either the action of CO on reduced Fe or of CO on FeO which is being reduced to Fe; that is, either



The results of about forty experiments prove that the first period of carburization in the blast furnace corresponds to the second of these reactions, and at a later stage to the first reaction; there exist transitional equilibria between. These reactions proceed from left to right at fairly low temperatures. Table III gives the percentage of CO present at equilibrium in each of these reactions at various temperatures, and in other extensive tables the equilibrium pressures exerted at various temperatures for various percentages of CO.

TABLE III. EQUILIBRIUM POINTS OF CARBURIZING REACTIONS

Temperature Deg. C.	Percentage CO at Equilibrium	
	$3\text{Fe} + 5\text{CO} \rightleftharpoons \text{Fe}_3\text{C} + 4\text{CO}_2$	$3\text{FeO} + 2\text{CO} \rightleftharpoons \text{Fe}_3\text{C} + \text{CO}_2$
685	.....	55.48
743	.....	75.49
744	.....	76.00
761	.....	80.81
772	80.22	.....
810	84.58	.....
814	.....	88.09
857	.....	89.68
907	89.15	.....
909	.....	92.45
963	.....	93.90
965	91.05	.....
968	.....	93.90
968	.....	94.28
1,014	93.12	.....
1,065	.....	96.64
1,070	.....	97.27
1,176	97	.....

Three applications of these principles are studied—viz., to case-hardening, malleabilization, and blast-furnace reactions.

In *case-hardening*, the author shows that Schenck's assumption that the isothermals of  $\text{Fe:Fe}_3\text{C}$ ,  $\text{FeO:Fe}_3\text{C}$  and  $\text{FeO:Fe}$  meet in a common point is untenable and contradicted by his data; this renders Giolitti and Carnavali's diagram, based partly on Schenck's assumption, also untenable, and leads to a quite different diagram. These matters have been discussed in METALLURGICAL & CHEMICAL ENGINEERING, April 1, 1917 (vol. 16, p. 385), and will be treated at length subsequently.

In *malleabilizing* that which it is desired to oxidize is iron carbide and not iron itself. The reaction should, therefore, be confined to



and not to be extended to



Then, it is clear that the oxygen-dissociation pressure of the gas surrounding the cast iron that is to be

malleabilized should be always a little higher than corresponds to the  $\text{Fe:Fe}_3\text{C}$  equilibrium proper to the adopted pressure; any larger excess of oxygen pressure should be avoided, as otherwise iron would be oxidized. This regulation of pressure can be performed by one of the following methods:

1. By the regulation of the velocity at which  $\text{CO}_2$ ,  $\text{O}_2$  or air is introduced into the reaction vessel.
2. By the regulation of the composition of the oxidizing gas; for instance, the ratio of  $\text{CO:CO}_2$  when a mixture of these gases is employed, the ratio of  $\text{O}_2\text{:N}_2$  when air is employed, etc.

By the analysis of the escaping gas the oxygen pressure of the reacting gas is easily determined, it is only necessary to determine the ratio  $\text{CO: (CO + CO}_2\text{)}$  in the gas, for the volume percentage of oxygen is negligible.

In the *blast furnace*, the influence of varying temperatures, varying pressures and varying compositions of gas form a highly complex problem. Assuming the CO plus  $\text{CO}_2$  to constitute an average of 36 per cent of the volume of the gases in the furnace, the sum of their partial pressure is fixed, and the problem becomes soluble. Taking the pressure and temperature distribution in the furnace as determined by Schlesinger as typical, the partial pressures of CO plus  $\text{CO}_2$  at the determined pressures become known, and the equilibrium conditions can be studied at various points in the furnace. This study leads to a remarkably instructive diagram, which shows in brief, that ferric oxide and magnetic oxide are reduced to FeO easily, but that the main reducing power of the furnace is used for the reduction of the ferrous oxide at 900 to 1,000 deg. C. The reactions are further effected by the displacement of equilibrium due to the  $\text{CO}_2$  from the limestone. The effect of removing moisture and enriching the blast in oxygen are evidently deducible from a study of the equilibria data determined in this investigation.

### Fluorspar Industry in Germany

The largest fluorspar fields in Germany are situated in the Hartz, Upper Palatinate, Thuringian Forest and Black Forest. The best quality is produced in the Upper Palatinate. The fluorspar found in the Upper Palatinate contains generally from 95 to 98 per cent of fluoride of calcium and relatively little silicic acid.

Most of the fluorspar is consumed at present by the iron industry. In the case of this kind of utilization, broken materials suffice. Other consumers are the glass industry and the chemical and enamel industries. These utilize fluorspar in a milled form, and together they use much less than the iron industry alone. According to a rough estimate made before the war it is calculated that the quantities supplied, respectively, to the individual industries are approximately as follows: Iron and metal smelting industry, 79 to 84 per cent; glass industry, 10 to 15 per cent; chemical industry, 5 per cent; enamel industry, 5 per cent; optical industry, 5 per cent.

The utilization of fluorspar in the iron industry has made steady progress in consequence of the shortage of coal since the armistice, since fluorspar increases the fluidity of the fusible material and thus effects an economy of fuel, although at the cost of the quality of the resulting product. Consequently, it is probable that post-war statistics will show an increase of the consumption of fluorspar by the iron industry at the expense of that of the glass industry.



## Armour Fertilizer Works—I

New Plant at Chicago Heights, Ill., Now in Operation—Model Chamber Process Producing Sulphuric Acid From Sulphur—Methods of Tower and Chamber Construction and Liquid-Handling  
Mark Advance Practice in Chemical Engineering

By CHESTER H. JONES

THE new plant of the Armour Fertilizer Works which has recently been brought into full operation at Chicago Heights, Ill., is an admirable example of what may be accomplished by the application of chemical engineering and the science of chemistry in the design of process and the operating control of a most essential industry. An extensive variety of mixed fertilizers for adaptation to any combination of soil and crop is produced with the control so carefully worked out in the blending of each lot of material that the actual chemical formulas may be stamped on every sack before shipment to the trade.

Mixing under the supervision of the chemist is, however, only a feature of the final stages of manufacture which will be later described.

One of the important initial steps is the manufacture of sulphuric acid from sulphur. The large building on the left in the illustration at the top of this page houses the sulphuric acid plant complete with the chambers as seen on the left, the towers in the intermediate high bay and the sulphur burners in the lower lean-to on the right.

This is probably one of the finest chamber plants in the United States. All the piping, flues, pumping systems, chambers, coolers, towers and tanks are so designed as to contain and convey the materials without the least evidence of mist, spray, fume or acid slop

at any point in the process. The stack where the final gases are emitted to the atmosphere with the plant in full operation never displays the slightest visible trace of either mist or niter fume.

### SULPHUR BURNING

The commercial sulphur is obtained from Southern companies, and arriving in box cars is shoveled to the storage pile in the end of the burner room. Thence it is drawn in wheelbarrows weighed over a Standard

platform scale and delivered to the burner doors as shown in Fig. 1. Twenty-four tons of sulphur is consumed every twenty-four hours to produce about 117 tons of 50 deg. Bé.  $\text{H}_2\text{SO}_4$ . The burners were designed by Armour Fertilizer Works engineers, the construction being essentially two units of six chambers each with common brick walls and firebrick arches and linings. Steel buckstays and rods support the walls and arches and the doors and frames



FIG. 2. TOP OF BURNERS AND EXIT FLUE



FIG. 1. FIRING DOORS OF SULPHUR ROASTERS

are made of cast iron. This constitutes all the metal work. There are no moving parts, sulphur simply burns on the hearths. Air is admitted in sufficient quantity to volatilize the sulphur to sulphur dioxide, the reaction being completed by the time the gases reach the exit flue. Fig. 2 shows this flue over the top of the burning chambers. It is placed between the two units, drawing gas from a common header. It is constructed from sheet steel lined with a double course of firebrick.

Located near the foot of the stack are three niter



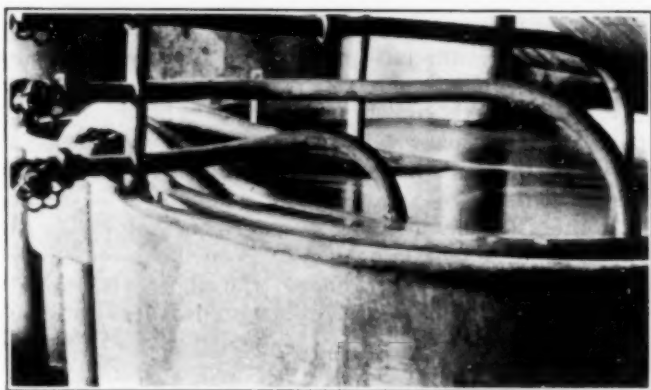


FIG. 4. ACID COOLER, SHOWING COILS BENEATH SURFACE

pots each 5 ft. long by 3 ft. wide by 3 ft. deep, cast by the Chalmers-Williams Co. The Chilean nitrate purchased on the open market is put into these pots and treated with sulphuric acid piped from the Glover tower outlet trough. (See Fig. 3.)

#### ACID TOWERS

The piers and floors supporting the brickwork of the towers proper are reinforced concrete. The steel framework surrounding and supporting the brick structure is heavily painted with asphaltum, and lead sheet is burned around the steel footings to protect from possible acid fume or slop. The lead pans (40-lb. lead) in which the brick floor of each tower is laid are first lined with asbestos paper and a  $\frac{3}{4}$ -in. layer of sulphate of lead mud.

#### GLOVER TOWER CONSTRUCTION

Three courses of brick laid flat constitute the floor of the Glover tower. Above the brick arches checkerwork of chemical brick is laid on edge for twenty-eight courses, commencing with 3-in. spaces between brick at the lower course and having 1 $\frac{1}{4}$ -in. spacing on the top course. The space above the checkerwork is filled for a distance of 9 ft. with quartz graded up from 6-in. size to 4-in. on the top layer. This completes the packing. The brick walls grade up from 20-in. thickness in the space occupied by the arches to 8 in. thick at the top of the tower. The brick is laid in silicate of soda up to top of lead pan (19 in.), the remainder being laid dry. The brickwork is surrounded outside with sheet lead supported by steel framework. The top is 14-lb. sheet lead.

#### GAY-LUSSAC TOWER CONSTRUCTION

These three towers are constructed after the same manner as the above except the space above the arches is filled with 6-in. diameter by 6-in. long spiral chemical tower packing for about forty-five layers and with 3-in. diameters by 3-in. long spiral rings for sixteen layers' distance at the top. The walls are 10-lb. lead sheathing with 4-in. brick lining laid dry. The top is 12-lb. lead sheet. All lead is supported from steel framework.

#### ACID COOLING TANKS

The coolers shown in the plan (Fig. 3) located at the foot of the Glover tower are further illustrated in Figs. 4 and 5. They are arranged to convey the acid either three in series or so that the first cooler may be bypassed. The acid is delivered from the last cooler at 60 deg. Bé. and 100 deg. F. (38 deg. C.).

Each cooler is supplied with five separate streams of

water as shown by the piping in the foreground, Fig. 5. Four of these leads connect into the four lead pipe coils seen beneath the surface of the acid in Fig. 4. After passing through these coils the waste cooling water empties into the basin at the left. These four waste pipes are shown leading into this catchbasin. It will be noted that the tanks have double walls with an annular space between. This space receives the fifth stream of cooling water from the vertical header, as shown in Fig. 5, and is discharged by a short connection to the same catchbasin as the four coil waste leads. There is space within each cooling coil for the addition of auxiliary coils as increased rate of plant operation may demand. The sixth lead as noted at the top of the manifold in Fig 5 is connected with an extra coil so inserted.

The acid flows from the Glover to the inner tank of the rear set (see Fig. 5) and overflows to the inner tank of the second set, thence to the third set. The complete flow of acid through the system of pipes and receiving tanks may be traced in Fig. 3. Water in this locality is very scarce, so all waste water from the coolers is carried to the cooling pond shown in front of the acid plant in illustration top of page 333. This water is handled by a 175-gal. Gould centrifugal pump direct-driven by a General Electric motor.

#### ACID-PUMPING SYSTEM AT TOWERS

The usual method of elevating acid over the towers by compressed air acid lifts has been departed from in the construction of this plant and after some experiments and tests the centrifugal pump was decided upon. Various economies have been claimed by manufacturers of both types of apparatus and each type has its merits as applied to individual installations and particular kinds of acid pumped. In this case the pumps have been operating continuously over a period of some months with a satisfactory showing.

The location of these pumps in the basement is shown in Fig. 3, and the illustration Fig. 6 is an interior view of the basement along the line of pumps and between

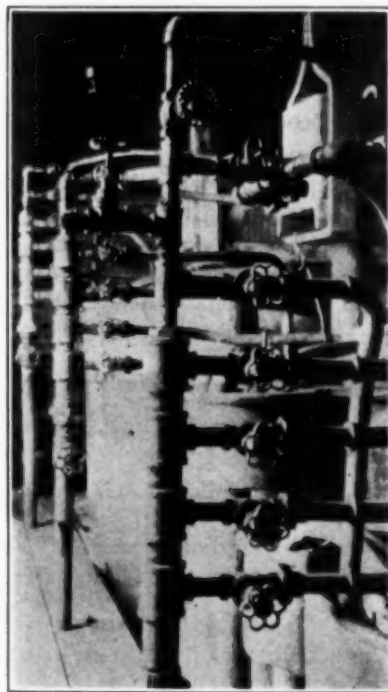


FIG. 5. ACID COOLERS, SHOWING COOLING WATER SUPPLY PIPING

the two rows of tanks. These machines are manufactured by the Chemical Equipment Co., Chicago, and are direct-connected to 5-hp., 1,750 r.p.m., three-phase, sixty-cycle Westinghouse induction motors, operated through controllers and cut-out switches of the totally inclosed type. These latter are seen mounted on the steel columns in Fig. 6 and are manufactured by the Trumbull Electric Mfg. Co., Plainville, Conn. Each pump has a 2 $\frac{1}{2}$ -in. suction and 2-in. discharge. The flow is controlled by a valve on the suction side so that a small

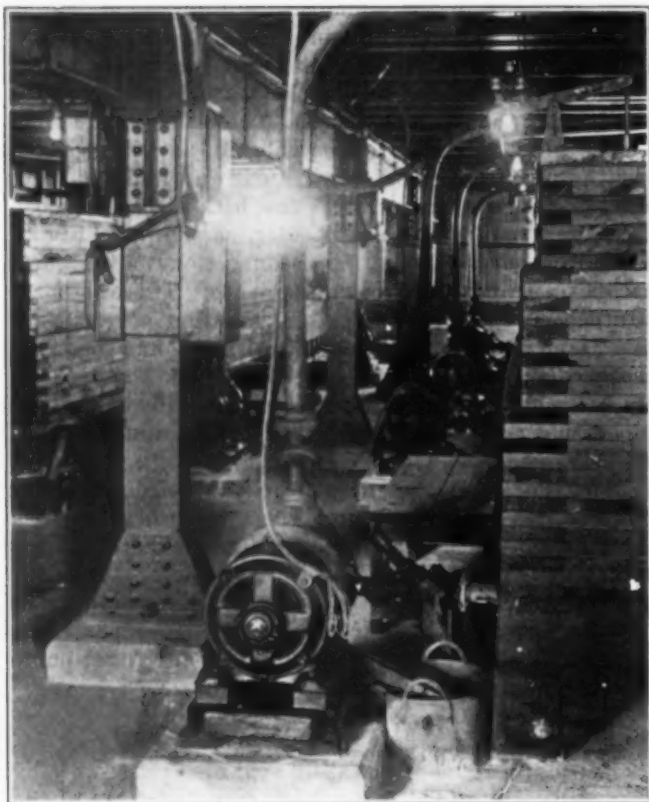


FIG. 6. ACID PUMPS AND TANKS IN BASEMENT

amount of air is drawn in through the stuffing box, obviating any acid leakage at this point. No vibration is noticeable when the pump is running at full speed, and it is therefore not necessary to bolt the base plate to the concrete foundation. All seven tanks on the first floor are independent, one pump drawing from each tank. The large tank on the left rear, Fig. 6, contains the supply of 53 deg. Bé. acid for the fertilizer plant. The connections for all pumps, including the line to the fertilizer plant, are shown in Fig. 3. Note that all lead plugs about the acid plant, upper right hand, Fig. 7, are conveniently operated by levers connecting to plunger rods made adjustable by means of set screws.

#### TANK FLOOR

The top floor over the acid towers supports five acid tanks as shown in plan and elevation, Fig. 3, and illustrated in Fig. 7. These tanks, as well as those in the basement, are built up from 2 x 8, 2 x 6 and 2 x 4-in. timbers laid on side, as shown, the whole being painted with black asphaltum, and lead lined. Each tank is equipped with splash box, shown near the posts, Fig. 7,

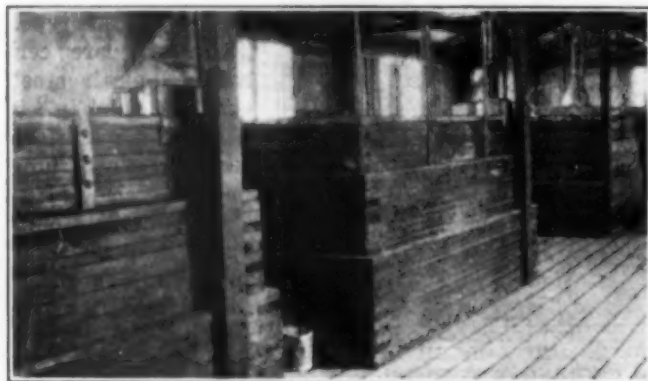


FIG. 7. ACID TANKS OVER TOWERS

and on the right in Fig. 8, with double float siphon and with float connected to telltale in basement for determining height of acid.

Fig. 8 shows the inside of one tank containing acid. The two large floats with the container between and into which the bent pipe leads constitute the double float siphon. This is so arranged as to deliver acid to the distributors on the floor below under constant head and flow. The large telltale float appears in the lower right-hand corner. The splash box in the upper right-hand corner receives the acid as it is pumped up from the basement tanks.

#### DISTRIBUTION FLOOR OVER TOWER

Fig. 9 shows one of the distributing pans with leads running into top of tower. The horizontal, lead-covered, steel rods carry the straps, which in turn support the lead roof of the acid tower proper. The pan, consisting of timber frame, lead-lined, is supported on two 6-in. double channels suspended from the roof trusses by 1-in. rods, each provided with turnbuckle adjustment.

An interior view looking down on top of the pan, Fig. 10, shows the rectangular gage box on the left, the

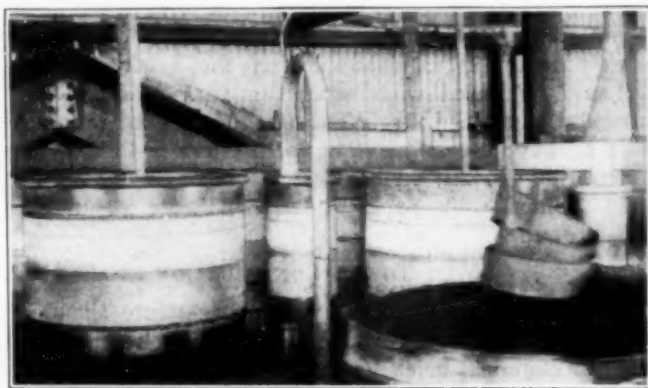


FIG. 8. INSIDE OF ACID TANKS

lead pipe leading from the bottom of this gage box into the side of the dome-shaped splash box. This latter is located in the center of the pan and permits the acid to flow into the pan through perforations. This in turn flows into the lutes, which are sealed to prevent the escape of tower gases by inverting ordinary glass tumblers as customarily practiced. The pipe leading into the top of the gage box, on the left, Fig. 10, comes directly from the double float siphon, as described, on the floor above. The complete arrangement appears in outline in Fig. 3.

As indicated in Fig. 3, the chamber system consists of six chambers in series. The fume passes from Glover

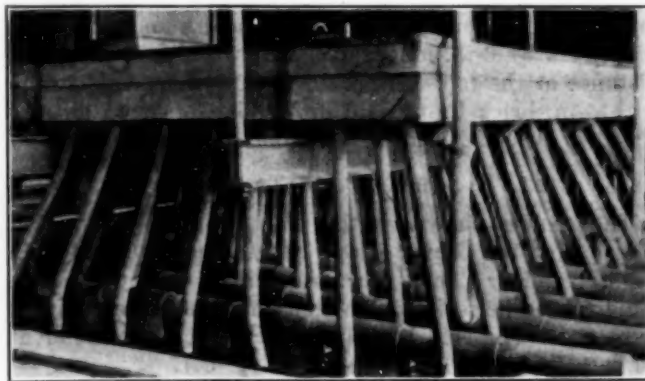


FIG. 9. DISTRIBUTION PAN ON TOWER FLOOR



FIG. 10. INTERIOR OF DISTRIBUTION PAN

and 3, the other between 3 and 4. These increase the efficiency of the system by serving as additional acid-making areas. They are built after the manner of the Gay-Lussac towers and filled with thirty-three layers of 6-in. spiral chemical tile.

The entire chamber system is supported on steel columns from beneath and each tower and chamber is constructed with steel framework, the whole being housed in a steel building sided and roofed with Keasby & Mattieson acid-proof corrugated asbestos.

The method of supporting the lead curtain walls of the chambers is well shown in Fig. 11. The steel channel girts with flanges turned upward carry 4 x 4-in. timbers rounded on the upper side. V-shaped lead straps were burned onto each lead sheet as erected, with the straps bent over the rounded timber and nailed as shown. When the weight of the curtain was thus gradually thrown on these straps they were slightly torn at the nail holes, permitting an equalizing sag at various points and so distributing the load as to obviate any wrinkles in the curtain. The excellent results obtained are evident to the most critical inspector. The roofs of the chambers were supported by loops of lead strap from I-beams in the same way as shown in the case of the tower roofs. (See Fig. 9.) Other evidences of excellency in the lead worker's art



FIG. 11. SIDE OF ACID CHAMBER

tower to chamber 1 and leaves chamber 6 by way of the overhead fume line, thence through Gay-Lussac towers 3 and 2. From tower 2 it is drawn through the Pratt exhauster, delivered to Gay-Lussac tower 1 and proceeds onward through the system. The exhauster is driven by a variable speed reducer as shown in Fig. 3, which permits changing the speed of the exhauster while running. Two intermediate towers are located in the chamber system, one between chambers 2

are shown in Figs. 11 and 12. The funnel in Fig. 11 is used for washing out the trough inside the chamber which slants downward to the test basin shown in Fig. 12. Here the hydrometer tests are taken, as well as the temperature readings from the thermometer directly above.

#### ACID SYSTEM AND SPRAYS

All chamber pans are so interconnected by lead piping that acid may be drawn from any single chamber or combination of chambers. Mixing acid for the fertilizer plant is drawn



FIG. 12. TEST BASIN ON SIDE OF CHAMBER

from the first chamber. The weak acid is carried over the Glover tower. No steam is furnished to the system. The water is introduced at the tops of the chambers through a series of stone cap and spiral 3-mm. Monarch sprays. The weak acid in the Glover tower generates enough steam in the gases to be effective through the first three chambers, but is supplemented by the water sprays beginning with the second chamber. The sprays are supplied with water from a pair of air pressure tanks located in the

basement, connected up with the National Brake & Electric Co. automatic air compressor, maintaining a constant head of 70 lb. While one tank fills with water from the mains the other is emptying under pressure to the spray system.

The operation of the entire sulphuric acid unit has exceeded the expectations of the designers. The visitor after viewing the installation and its operation would call it a perfect acid plant.

*The fertilizer plant and acid phosphate manufacture will be described in a subsequent issue.*

#### Varieties of Kongo Trees Producing Tannin

According to a recent article in the *Exportateur Belge* there are numerous trees in Kongo with barks rich in tannin. Among these is the Mwena, a species of mangrove abounding on the banks of the Lower Kongo and its tributaries, the bark of which contains a minimum of 15 per cent of tanning matter, the trunk and the roots producing an extract running from 50 to 55 per cent of tannin. The wood itself, which is hard and undecaying, is a valuable byproduct adapted for use in the construction of piling, railroad sleepers and ships. Several varieties of the *Terminalia* give barks which render a dry extract entirely soluble when cold and containing 62 per cent of tannin. This extract produces an extremely light and well-tanned leather.

Other varieties of native trees also produce tannin extracts, hence the tanbark industry is one of great potential importance for the Kongo.

## Causes of Piping in Aluminum Ingots

Measurements of Piping and Solidification Shrinkage Show That the Volume of a Pipe Is Dependent on Four or Even More Definite Factors, and That It Is Not a Specific Property of a Metal or an Alloy

By JUNIUS DAVID EDWARDS\* AND HAROLD T. GAMMON†

IN THE preceding papers (CHEMICAL & METALLURGICAL ENGINEERING, Vol. 24, Nos. 2 and 5, pp. 61 and 217) the density of aluminum and the copper: aluminum alloys at temperatures from 20 to 1,000 deg. C. were given. From these data the complete density curves were constructed for this range of temperatures, and the solidification shrinkage was estimated with good precision. Solidification shrinkage is responsible for the piping of the metal when it is cast, and because the extent to which piping occurs is a factor in determining the suitability of a metal for casting purposes it seemed desirable to analyze the relation between the amount of shrinkage and the observed piping. An attempt has therefore been made to determine quantitatively the amount of piping which occurs in casting aluminum and some of its alloys. Although this attempt was not entirely successful, mainly because the amount of piping which occurs is far from being a definite quantity, nevertheless the work has led to a much clearer conception of the factors controlling the formation of pipes in castings. This article is in the nature of a memorandum of experiments completed and conclusions reached, rather than a complete summary of the problem.

### MECHANISM OF FORMATION OF PIPES

Before considering the problem of the pipe it will be well to consider the volume changes which occur on freezing. In Fig. 1, Curve A, is shown the relation between temperature and specific volume, which is the volume in milliliters per gram of pure aluminum. Starting with the liquid metal, the contraction on cooling is slow and uniform until the freezing point is reached; at this temperature a large contraction in volume takes place during the solidification. The solid metal then contracts slowly, but at a somewhat different rate from the metal in the liquid state. Curve B shows the same relations for an alloy of aluminum with 4 per cent of copper. The most characteristic difference to be noted is that solidification no longer takes place at constant temperature, but over a considerable range of temperatures, amounting in this case to approximately 100 deg. C. Curve C shows the change in specific volume of the alloy of aluminum with 8 per cent copper. This is somewhat different than in the preceding case, because part of the solidification takes place at constant temperature. The 8 per cent copper alloy contains approximately 15 per cent of the eutectic mixture when it has cooled to a temperature of 540 deg. C. and this eutectic freezes at constant temperature in exactly the same way as a pure metal. These three curves show the characteristic volume changes on freez-

ing of the pure metal and two of its important binary alloys.

Briefly, the formation of the pipe in casting an ingot takes place in somewhat the following manner: The metal which is in contact with the walls of the mold cools to the freezing temperature first, and there solidifies to form a solid shell which grows in thickness by the continued solidification of the metal. Because there is a contraction in volume of the metal upon solidification, the level of the liquid contained within this shell of frozen metal is continually lowered during the course of the freezing. If no additional metal is supplied during the freezing process, a conical-shaped cavity known as a pipe is formed. The main function of the gates and risers is to supply the metal required to keep the mold completely filled during the solidification and consequent contraction of the metal contained in it. With reference to Fig. 1, Curve A shows that the contraction on freezing in the case of

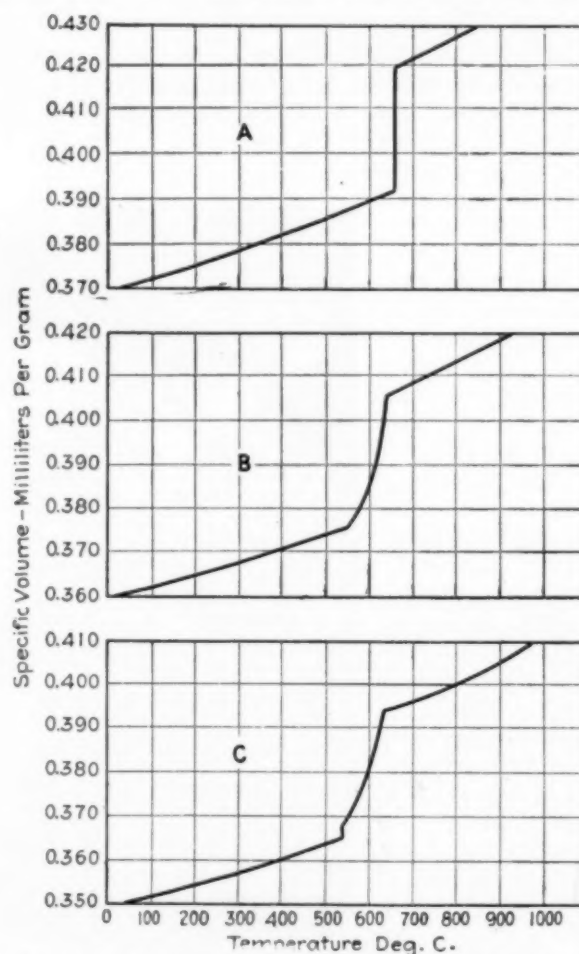


FIG. 1. RELATION BETWEEN TEMPERATURE AND SPECIFIC VOLUME

\*Physical Chemist, Aluminum Company of America.

†Chemist, Aluminum Company of America.

pure aluminum is about 6.6 per cent, and consequently 6.6 lb. of aluminum must be fed into the casting from the gates for every 100 lb. of casting. In the case of the 4 per cent and 8 per cent copper alloys the contraction upon freezing is of approximately the same magnitude.

The volume of the pipe is not, however, necessarily equal to nor proportional to the contraction upon freezing. In the case of pure aluminum the two are very nearly alike. That this is nearly so comes from the fact that the shell first formed in the casting of the pure metal is quite rigid, and the contraction during freezing necessarily appears in the form of a central cavity. In the case of the alloys, however, the solid which separates during the first part of the freezing process is a network of crystals more or less interpenetrated by liquid. This mixture may be quite plastic and the shell which first forms in the mold is not so rigid as in the case of the pure metal. This is of advantage in casting practice, because it permits the casting to adjust its form somewhat upon cooling without straining the cores or other fragile parts of the mold. As a result, the mixture of partly frozen metal within the mold behaves as if it was still liquid for a considerable interval of temperature below the commencement of freezing. As a consequence the volume of the pipe which is formed with the alloys is less than is the case for the pure metal. The apparent volume of the pipe may also be reduced in some cases by the formation of a porous structure at the top of the ingot, gate or riser where the final freezing occurs. This happens if the network of crystals at the surface possesses sufficient rigidity to allow the eutectic to withdraw from between the crystals during its solidification, thus leaving voids in this part of the metal. Part of the pipe is then disseminated and concealed within the body of the metal.

#### EXPERIMENTAL METHOD

The following method was employed to determine the relative piping effect with different metals: A graphite crucible having a capacity of approximately 225 c.c. was filled with slightly more than that volume of molten metal, after which a hot iron plate was pressed down upon the surface of the crucible and the metal. The plate forced out the excess metal so that the crucible contained exactly its known volume of metal at that average temperature. After the metal had solidified, the ingot was removed and the exact volume of the pipe was determined by filling with mercury and then weighing the mercury. A piece of paraffine-coated paper with a straight edge was wrapped tightly around the ingot and fastened in place in order to sharply define the upper edge of the pipe in case it was irregular or not level. An attempt was made, by controlling the pouring temperature, to have the metal freeze sharply at the edge of the crucible, so that the volume of the pipe might be sharply defined. This was a difficult condition to obtain with most of the alloys. The pipe in the ingot is measured at room temperature, and is therefore smaller than it was at the freezing point of the metal, because of the shrinkage of the metal in the solid state. The correction for this has been calculated from the solid shrinkage of the metal and the volume of the pipe then expressed as a percentage of the volume of the mold, which volume was the original volume of the ingot before cooling.

The solid shrinkage, which is the relative change in

volume of the solid metal in cooling from the freezing point to room temperature, was determined by casting in a sand mold a bar about 2 ft. long. The ends of the mold were formed by two graphite blocks which were rigidly held a known distance apart by steel plates; these were so arranged that the heat from the metal did not cause any appreciable expansion of the steel plates before the metal in the mold had set. The space between these graphite blocks was filled with solid metal at the freezing point. Knowing the distance between the graphite blocks and the length of the bar when cold, the shrinkage expressed in inches per foot of original length may be readily calculated.

The results of a series of measurements on the volume of pipe and the solid shrinkage of aluminum and some of its alloys with copper are given in Table I.

The observed piping effect with the aluminum was 7.7 per cent, and with the 8 per cent copper: aluminum

TABLE I. THE PIPING EFFECT IN ALUMINUM AND ITS ALLOYS

Composition	Volume of Crucible, ml.	Pouring Temp., Deg. F.	Solid Shrinkage, Inches per Ft.	Volume of Pipe, ml.	Corrected Volume of Pipe, ml.	Piping Effect, Per Cent
Aluminum, 99.4%.....	239	1,550	0.21	17.4	18.3	7.7
Al + 4 Cu.....	223	1,300	0.19	9.6	10.0	4.5
Al + 6 Cu.....	223	1,300	0.18	9.4	9.8	4.4
Al + 8 Cu.....	239	1,300	0.18	8.7	9.1	3.8
Al + 10 Cu.....	223	1,300	0.17	6.8	7.1	3.2
Al + 12 Cu.....	223	1,300	0.17	6.7	7.0	3.1
Al + 31 Cu.....	223	1,300	0.15	12.4	12.9	5.8

alloy was only 3.8 per cent. This at first appears anomalous, in view of the fact that the solidification shrinkage is approximately the same in both cases (6 to 7 per cent; see "Mechanism of Solidification of a Copper: Aluminum Alloy," *CHEMICAL & METALLURGICAL ENGINEERING*, vol. 24, No. 5, p. 217). A reasonable explanation for this difference in behavior has already been given in a preceding paragraph. It may be illustrated more clearly by reference to Fig. 2, where the

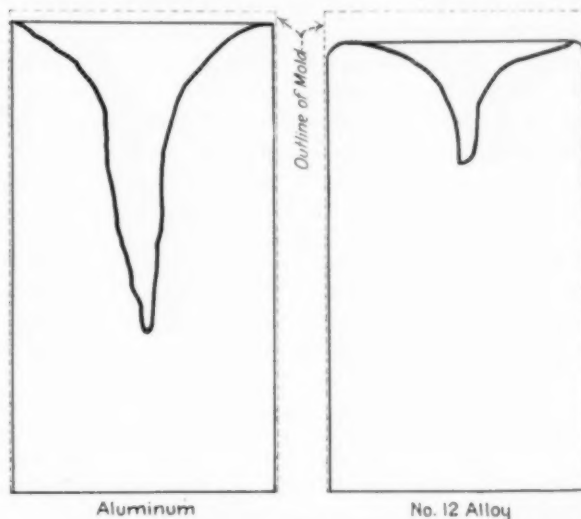


FIG. 2. VERTICAL SECTIONS THROUGH CENTER OF INGOTS

experimental ingots for the pure aluminum and the 8 per cent copper alloy are shown in section. It will be noted that the ingot of No. 12 alloy is shorter than the aluminum ingot and that the upper edges are very much rounded off, whereas in the aluminum ingot the metal has frozen sharply at the edge of the crucible. In the aluminum ingot the total contraction during solidification is represented by the volume of the pipe. In the alloy ingot part of the contraction has been

taken up by a readjustment of the shell initially formed in the mold, a fact which is attested by the appreciably shorter length of the alloy ingot. This difference in length is more striking when it is considered that the linear shrinkage of aluminum after solidification is greater than that of No. 12 alloy. In the case of the ingot of No. 12 alloy shown in the figure, its average length was about 11.2 cm., whereas it should have been nearer 11.7 cm. in length if the crystals had remained in place as they solidified at the walls. When allowance is made for this fact, it is found that the total solidification and liquid shrinkage was about 6.3 per cent, which is in fair agreement with the contraction indicated by the graph, making due allowance for the approximate nature of the measurements made on the ingot.

The piping effect gradually decreases with increase of copper, but there is very little decrease noted beyond 10 per cent. However, the sample containing 31 per cent copper and which is very nearly of eutectic composition shows a larger pipe than some alloys of lower copper content. This is what might be expected from our analysis of the mechanism of piping, because the eutectic alloy in freezing behaves essentially as the pure metal. Consequently there should be some alloy of intermediate composition which would show a minimum piping effect.

The volume of pipe formed in any given alloy is a complex function of the following factors: (1) The percentage contraction during solidification; (2) the rate of solidification during the freezing interval; (3) the temperature range of the freezing interval; (4) the size and form of the mold and probably some other conditions. Because the volume of the pipe is dependent on conditions external to the metal, it is not even certain that different alloys would give the same relative piping effect in one mold that they would in another. It is, accordingly, impossible to describe piping as a definite property of a metal. The contraction upon freezing is, however, a perfectly definite property which can be defined and measured and is the fundamental cause of piping. The values given in the table should therefore be considered in the light of this discussion whenever any use is to be made of them. It should also be borne in mind that the casting properties of a metal are not solely defined by the piping effect. It is only one important factor to be considered. A low solid shrinkage, for example, is of course very desirable in a casting alloy in order that the strains which are set up in a casting on cooling may be reduced to a minimum.

#### SUMMARY

A method of determining the piping effect in metals is described, and the results of measurements on a series of copper:aluminum alloys are given. It is shown that although the solidification shrinkage of a metal is responsible for the formation of the pipe, it is not necessarily proportional to it. The good casting properties of the 8 per cent copper alloy are not to be ascribed to a low solidification shrinkage (which it does not possess), but to the manner in which it freezes. The explanation given is not offered as a general formula for all alloys, but it is thought that the results obtained may be suggestive and helpful in many other cases.

Research Bureau,  
Aluminum Company of America,  
New Kensington, Pa.

#### Graphite Situation in Ceylon

Consul Robert L. Keiser of Colombo reports that the graphite trade of Ceylon reached a minimum in 1919, dropping from an exportation of over 33,000 tons in 1916 to 6,671 tons in 1919. The first five months of 1920 showed a slight increase, 4,235 tons having been exported. Of this amount the United States took 2,800 tons, or about 70 per cent of the total.

#### COMPARATIVE EXPORTS FOR RECENT YEARS

Exportation for the last four years has been as follows, the figures for 1920 being for five months:

Countries	1917, Tons	1918, Tons	1919, Tons	1920, Tons
United States.....	21,965	8,178	3,995	2,800
United Kingdom.....	4,600	6,386	2,260	1,062
India.....	145	293	88	31
Australia.....	237	288	146	188
Japan.....	.....	61	80	117
All other.....	200	11	102	37
Total.....	27,047	15,217	6,671	4,235

The great slump in exportation has led to the closing of the majority of the small mines. During the peak of production (1917) about 1,300 mines were in operation, but at the beginning of 1920 less than fifty mines were working. It should be noted, however, that most of the mines in operation are those which are able at short notice, or with little preparation, to mine the bulk of the production.

#### COMPARATIVE PRICES

The average value per ton of all grades of graphite exported in 1913 was \$110 (330 rupees) and in 1917 about \$300 (900 rupees). In 1918 this figure decreased to about \$100 (300 rupees); in 1919, to \$104 (260 rupees); in 1920, to \$105 (230 rupees). It is difficult to estimate these values in terms of dollars, owing to the rapid fluctuation of exchange.

It is interesting to note that in 1913 the average value of graphite exported to the United States, United Kingdom, and Germany (these being the three largest consumers in the order named) was about the same for each of these countries. In 1918 the average value of the graphite exported to the United States was about \$130 per ton, against \$80 for the United Kingdom, and a general average of \$100. In 1919 the imports to the United Kingdom averaged \$70 per ton, while those to the United States were valued at \$130, the general average having been \$104. Statistics for the 1920 period show that the average values of exportation to the United Kingdom and the United States are again about the same, namely, \$108 and \$113, respectively.

No statistics are available covering production costs. The producers claim that on the present basis of prices there is not sufficient profit to make production interesting to them. Since 1913 wages have increased about 25 per cent. Barrels for packing, which formerly sold for 12.50 rupees, now cost 25, and the increased cost of explosives is large. It is therefore evident that but little profit is left to the miners at the present average price.

With the exception of three companies the mining operations are all in the hands of natives. There is no restriction against foreign companies owning mining properties or carrying on mining operations.

The Ceylon government assesses an ad valorem duty of 3 per cent on all graphite exported from the island.

## Plant Design for Hot-Gas Pyrolytic Distillation of Shale

Description and Plan of a 2,000-Ton per Day Shale Oil Plant Operating on Indirect Heating Process Employing Hot Gases for Conveying Reacting Heat and Resultant Oil Vapors From Pyrolysis of the Shale

By LOUIS SIMPSON

AT THE present time it is no longer necessary to point out that the consumption of hydrocarbon oils has overtaken the supply; that the amount of such oils obtainable from the hitherto source of production is probably close to the maximum and that the world's ever-increasing requirement must in the future be secured from new sources of supply.

It is probably superfluous to state that such much-to-be-desired new sources of supply have been found in the oil-yielding shales, sands and rocks that are known to exist on all continents and in many districts of each continent. Admitting that such new sources of supplies exist, it must be confessed that the crux of the whole question is the availability of economic methods by which the volatile contents may be recovered from them at a cost that will give sufficient monetary return upon capital invested in their operation.

The world's requirements cannot be satisfied unless works of commercial capacity are operated. Even shales that are relatively lean in volatile contents must be profitably retorted where conditions are not unfavorable. It is not sufficient that works and processes be developed that will commercially retort shales very rich in kerogen. It is not desirable that shale works be erected for the production of other than standard oil products with the expectation that these specialties can be marketed at high prices. The markets for such specialties would soon become oversupplied, with the result that their manufacture would cease to be remunerative.

It is necessary that works be erected and processes used that will make possible the retorting of relatively lean shales at a profit when selling the manufactured products in markets that are not likely to become depressed through competition.

### FUEL SUPPLY MOST IMPORTANT QUESTION TODAY

The year 1920 has proved that a constant and an assured supply of fuel at reasonable prices is the most important question on this continent today. Without an adequate supply of fuel there would have to be a reconstruction of the industries of many parts of the American continent. The present development of hydro-electric power and the possible future development of such power may mitigate but cannot solve this difficulty. Fuel to produce light, heat and power, fuel that can be readily and, as to cost, reasonably transported to the place where it is to be consumed, is today a necessity.

Years ago the world relied upon the combustion of wood and peat for the required heat and upon the combustion of fats and oils (vegetable, animal and fish) for the very indifferent quality of light with which the inhabitants of the world had to be content in those days. Today the wood and peat are largely replaced by coal, hydrocarbon oil, natural gas and electricity. Of these

the natural-gas supply will give out before many years, while the cost of coal is likely to be much higher in the future than it was before the war. Today, for reasons appreciated by combustion and power engineers, oil has become a factor fully as important as coal, and, as the economic possibilities of liquid fuel become more widely appreciated, it is likely to become of even greater importance.

### THE COMMERCIAL PLANT

Outside of Scotland, the works constructed up to date to undertake the retorting of oil-yielding shales, while fairly numerous, have been relatively small. The limited capacity of these works has been fatal to their commercial success. A commercial retort plant must be of a capacity sufficient to warrant the employment of and the expenditure upon:

1. The necessary technical staff.
2. Machinery of a capacity that will permit of economy of operation.
3. Labor-saving devices.
4. Railway sidings, roads, pipe lines, tank cars and vessels, with their several necessary auxiliaries.

The overhead charges in a works of small output, retorting lean shale, would probably eat up all the profit. This is no new problem in the mining industry. Mineral deposits that are lean must of necessity be mined and treated in a large way, and when so handled have often been proved to be more profitable than richer deposits.

It is fortunate that in the oil-shale industry the underlying chemical principles that govern the retorting of the shale have been established and proved years ago. Today all that remains to be determined, besides the more perfect elucidation of some of those principles, is the most economic application of those principles under the local conditions existing. The Scotch operators fought this question out in Scotland over twenty years ago and devised retorts and methods that suited their special local conditions. Unfortunately the local conditions that once existed in Scotland no longer exist there in their entirety, and are not duplicated on the continent of America.

During the last twenty years many and very important advances have been made in the science and art of combustion, in the conservation of heat and in the production of power and heat; also in the conveying and crushing of ores and similar raw material, in the pumping, softening and filtration of water and in labor-saving machinery generally. Moreover, the laws that govern aggregates are better understood, and during recent years notable advances have been made in the production and in the use of measuring, indicating and recording instruments to measure the flow, temperature and quality of gases, etc., which make possible the refinement of processes not possible when these processes

are directed by rule-of-thumb methods. These advances have made possible economies hitherto unthought of. Some of these improvements have been adopted in part in Scotland, but the majority have not been adopted, as this would have entailed an almost complete rebuilding of the several plants.

#### PLAN OF A COMMERCIAL PLANT

A commercial retort plant should be planned so as to be:

1. Condensed into an area as small as possible without being congested.
2. Fire-resisting and fool-proof.
3. Capable of continuous operation for a long period.
4. Not requiring frequent attention for small repairs.
5. Should require an irreducible minimum of manual labor.
6. Also the minimum consumption of heat, power and water.

#### GOOD ENGINEERING WORK ESSENTIAL

These requirements indicate that it is not so much the services of an expert chemist, whether for research or for planning, that are called for, but the services of chemical, combustion, power and mechanical engineers. It is with no desire to belittle the work that can be done, and, indeed, which it is hoped will be done by the research chemist toward the elucidation of certain chemical reactions which at present are not fully understood and other and similar details about which reliable information would be of immense help, but it would appear to be very necessary to point out that the problems that surround the construction of a commercial retort plant are not of a character that a research chemist, and a research chemist alone, can best solve.

The retort plant described in this article is the result of six years' constant development work. It is based upon the employment of chemical principles accepted by the Scotch operators, but the application of these principles has been made to conform to modern practice. This application has been carefully scrutinized and has been approved by chemists expert in gases. The writer has for thirty years made power production a study, having designed and constructed the first hydro-electric power plant operated in Canada. In planning that power plant new improvements were made that since have become standard. The economical production and transmission of power is a science, and the application of this science is influenced to a greater extent than is usually appreciated by the varying factors of local conditions, hence experience is of unusual importance, and the use of theory unattended with experience may result in trouble. As local conditions generally vary within wide limits, it is necessary to plan those parts most affected so that modifications may be made without disturbing the plant as a whole.

#### PLANS AND LAYOUT OF PLANT

The plant, as illustrated in Fig. 1, is designed to retort 2,000 tons of shale each twenty-four hours. The process commences with the crusher house. The shale is assembled in the works, as shown in the drawing, by the use of an aerial conveyor, such method of assembling possessing certain advantages when used under the conditions usually found in Canada. Such alterations as are necessary to make the crusher department suitable to operate in connection with any other system of assembling can easily be made, as such alterations will

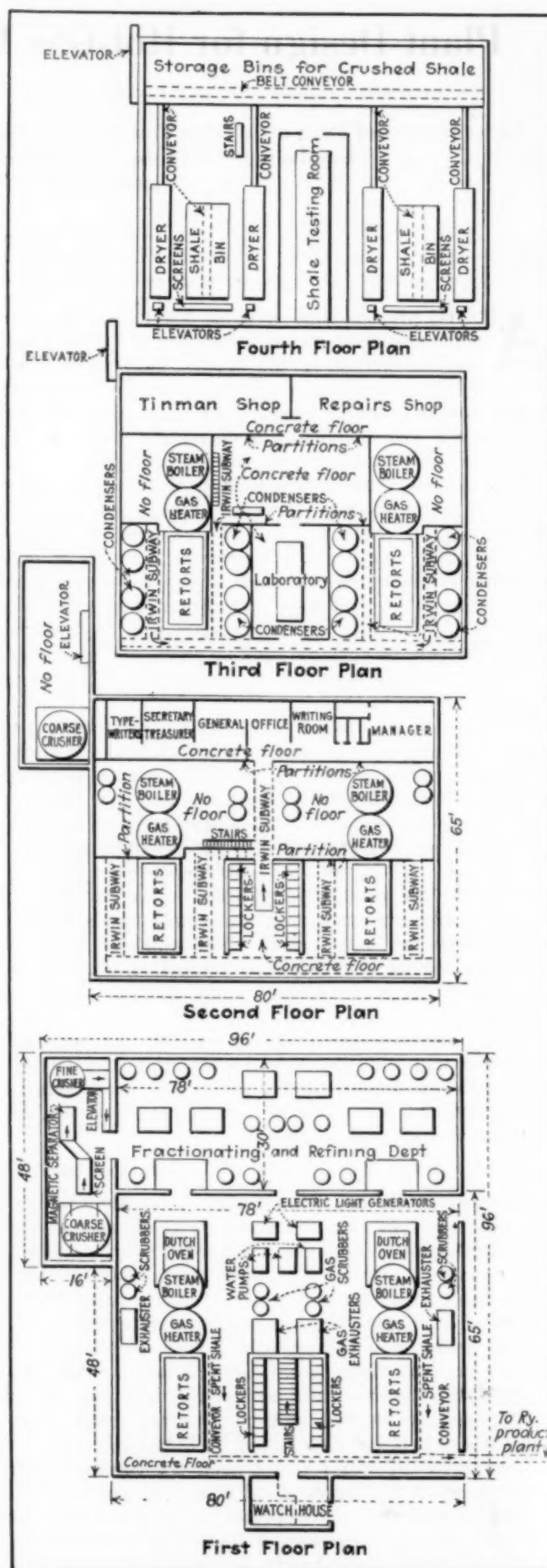


FIG. 1. FLOOR PLANS OF PLANT

be simply matters of detail. The byproduct departments are not shown, their consideration being left for another article. The plan of works exhibited is so arranged that a byproduct plant can be added without disarranging the oil-recovery plant proper.

The crusher plant consists of a coarse crusher, a fine crusher, two screens to remove the "fines" and to return the oversize to the crushers, and a magnetic roller to remove "tramp iron."

The fine-crushed shale is elevated to a shale bin of large capacity located on the top or fourth floor. From this bin the shale is conveyed into and through driers, and from the driers passes through special screens to obtain the removal of the last of the fines, and then is

the shale into each chamber in a constant dribble. The feeder is so designed that the top of the shale in each chamber assumes the shape of a pile with two long sides or slopes, thereby presenting the greatest possible surface to the action of the preheated gases with which the space unoccupied by the shale is kept filled.

#### RETORTING CHAMBERS

Each chamber of the double retort is rectangular in shape at the feed end. The two chambers of each double retort combine to form one chamber at the discharge end, where are located two discharge rollers, which by rotating keep the charge of shale in constant movement, passing down and through the chambers.

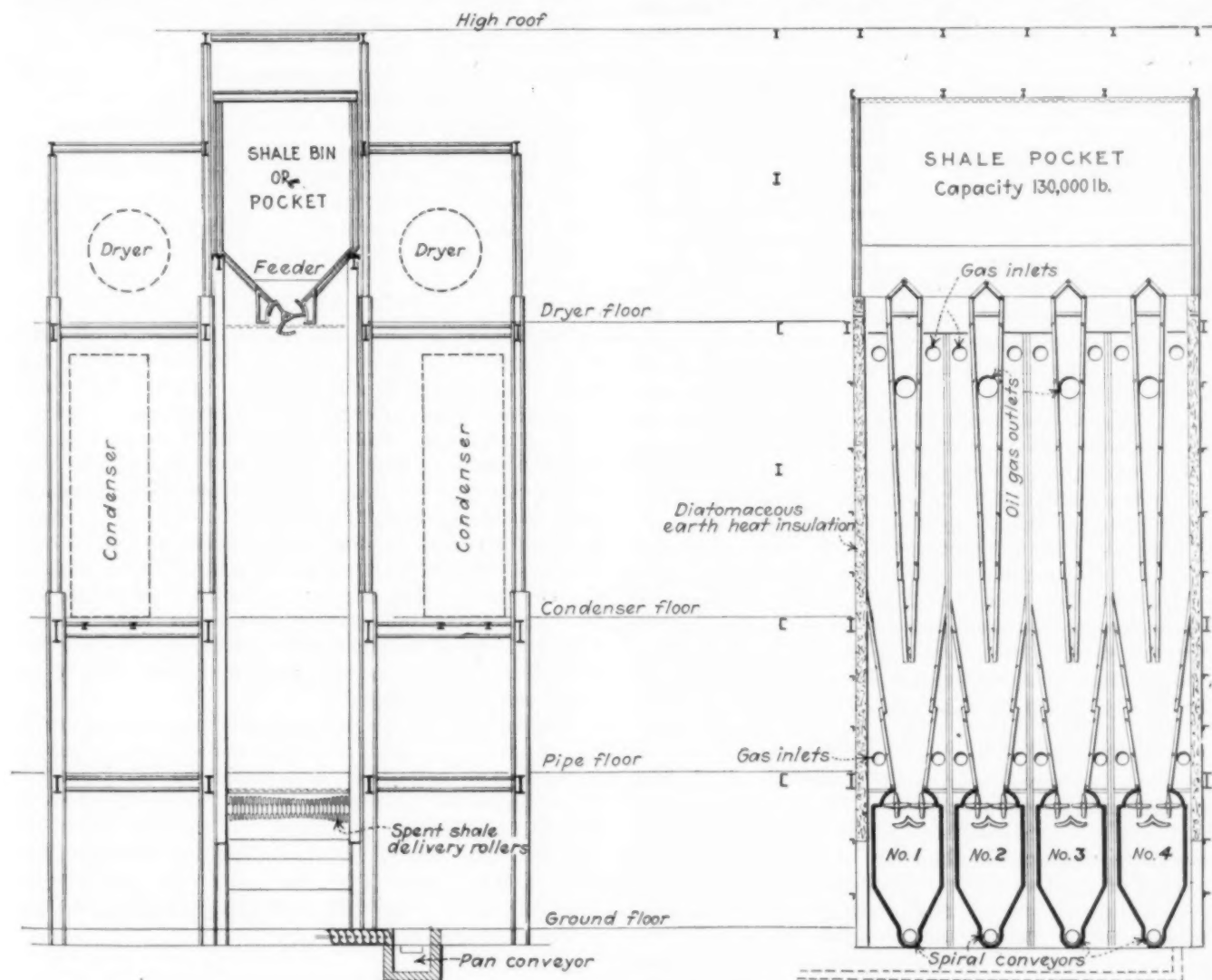


FIG. 2. CROSS-SECTION OF RETORT CHAMBERS

conveyed into the feed bins, situated over each bench of retorts. Under certain local conditions these driers may be dispensed with. The driers are heated by the waste products of combustion of the steam boilers after those products have yielded the major part of their contained heat during their passage through the gas preheater. The objective of these driers is to enable the shale to be passed into the retorts, at all times of the year, possessing a similar physical condition. From the shale bins over the retorts the shale is passed into each of the two chambers of the four double retorts (four double retorts form a bench of retorts) by special but very simply constructed feeders. These feeders pass

The chambers are so designed that this movement is constant and is not subject to obstruction. The heat required to secure the eduction of the volatile contents is supplied by the admission of preheated gases, the product of a previous operation. These gases are admitted into each chamber at several points, two of which are located at the feed end of the chamber. The volume of these gases can be regulated. It is claimed that not only do these preheated gases heat the shale to the necessary temperatures for eduction but that they:

1. Act as a carrier for the oil vapors formed by pyrolysis.

2. Act as a diluent, lowering considerably the vapor pressures and temperatures required for eduction.

The gases and oil vapors are removed from the chambers at several points through apertures specially designed, so that they will not become clogged through the accumulation of deposits, which deposits can be conveniently and quickly removed as formed.

The light-oil-vapor-gas mixture comes over first, and the vapors are condensed by being passed through water-cooled condensers. The heavy-oil vapors are removed and condensed separately. The fluidity of both these gas-vapor mixtures is greatly increased by the thinning action of the gases used for heating the shale. The presence of these gases also mitigates, if it does not altogether prevent, certain troubles that at times are likely to occur in the condensers. The partial fractionation of the light-oil vapors from the heavy-oil vapors also makes possible economies in the topping of the light oils and the economic production of the highest grade of fuel oil.

The water used for condensing the light-oil vapors is used afterward in the heavy-oil vapor condensers, from which it is delivered at a temperature sufficiently high to permit its being fed directly to the boilers.

The retort chambers are fabricated of steel plates. The bench of retorts is inclosed on all four sides by two walls of steel plates, placed some inches apart, the inner plates being welded together so that they are gas-leak-proof. The space between the two rows of plates is filled with heat-insulating material such as kieselguhr.

The division plates that form the several chambers are fastened to the inner of the two plates that form the walls of the bench. As none of these plates are subjected to a critical temperature, it is evident that these parts of the retorts will last for many years. It is also evident that the shale retorted in these chambers, subjected as it is to a regulated heat, every piece of shale being also subjected to the same temperature, will, however rich in kerogen the shale may be, never become burned on to the sides of the retort and thus cause "bridging" of the shale within the retort, and it is also certain that none of the educed gases are likely to be cracked.

#### COOLING CHAMBER, CONDENSERS AND SCRUBBERS

After being removed from the retort the spent shale is passed into a cooling chamber. When passing from the rollers into this chamber the spent shale is deflected toward the walls of the chamber. These walls are constructed of steel chambers, which are cooled by water. When certain qualities of shales are retorted these tanks can be used to generate low-pressure steam, which as generated is passed into and among the spent shale. The cooled spent shale is removed from the cooling chamber and by the use of suitable conveyors is transported to the byproduct plant, where it is treated specially to recover the maximum yield of ammonia at the lowest cost.

The oil vapor condensers are located on the third floor close to the retorts the vapors from which are to be condensed. Each double retort has two condensers, one for the light-oil vapors and the other for the heavy-oil vapors, the pipes connecting each condensor with its retort being each less than 10 ft. in length. The fixed gases pass into main pipes and are exhausted into gas washers, one for the purpose of recovering the non-condensed gasoline and the other to recover any ammonia that may have been carried away with the gases. From the latter washer the gases pass to gas

holders, from which supplies are drawn to provide gas fuel for the boilers and gas to be heated in the preheater. It is arranged that when in regular operation there shall be burned under the boiler just enough of the gas to maintain a constant quantity of gas stored in the holders.

#### GAS CYCLE

The steam is generated in vertical water tube boilers of special construction supplied with gas burners of suitable design. The gas preheaters are so constructed that they can be operated constantly for long periods of time and at the greatest efficiency. By the arrangements provided the efficiency obtained from the fuel gas burned will be very high.

The gas cycle is as follows:

1. Gas holder to steam boiler.
2. Steam boiler to gas preheater.
3. Gas preheater to driers.
4. Driers to byproduct recovery or to the air.
11. Gas holder to gas preheater.
22. Gas preheater to retorts.
33. Retorts to condensers.
44. Condensers to exhausters and washers.
55. Washers to gas holders.

#### POWER DISTRIBUTION

The manner in which the power required is provided is new and is probably unique. By referring to the illustrations it will be noted that no central power house is provided. The power within the works will be generated by individual steam turbines taking steam from the steam boilers at high pressure and passing the condensed steam to the byproduct plant, where it is used in the process of manufacturing. The individual steam turbines used are dust-proof, gas-proof and fool-proof. They will require no more, if not less, attention than do electric motors, will require but small repairs and can be operated continuously for unusually long periods. The total cost is less than that of a central power house with electrical transmission and electric motors and the steam efficiency is higher.

The topping of the light-gas oils is arranged for in the fractionating and refining department. Should it be desired to fractionate and refine the heavy-gas oils an addition for this work would be located directly behind the building in which the light-oil gases are treated. The byproduct department in which the spent shale would be treated for the recovery of nitrogen and (in a few cases) of potash would be located to the right of the retort building.

#### FIGURES ON COST

Figures on the cost of operating such a works are not usually a criterion of much importance, especially as there are very many different methods of stating such costs. The writer has preferred to adapt a method used for many years in other industries, in which the cost of wages in each department is given separately, while the repairs, depreciation and overhead are given separately but as affecting the whole manufacture. As wages differ greatly, it has been thought reasonable to give the days' labor required calculated at an average rate of \$5 per day, a day usually being one of eight hours' work. With these data it is easy for any one to calculate the costs under such local conditions as may exist. The cost of mining and assembling vary within wide limits, from the low cost of excavating by power-

operated excavators under ideal conditions to deep mining. Such costs may vary from 25c. per ton up to and over \$2 per ton.

Crushing.....	10 men at \$5 per day...	\$50, or 2.50c. per ton
Retorts.....	15 men at 5 per day...	75, or 3.75c. per ton
Power.....	9 men at 5 per day...	45, or 2.25c. per ton
Spent-shale....	6 men at 5 per day...	30, or 1.50c. per ton
Warehouse.....	11 men at 5 per day...	55, or 2.75c. per ton

Total wages.. 51 men at \$5 per day... \$255, or 12.75c. per ton

Salaries, including foremen, chemists and management, \$1,120 per week.....	8.00c. per ton
Repairs.....	5.00c. per ton
Taxes, insurance and sundries.....	5.00c. per ton
Depreciation.....	15.00c. per ton
Bond interest.....	15.00c. per ton

Total..... 60.75c. per ton

The foremen should be expert artisans, expert in their several trades, and would thus be competent to attend to any small or minor repairs requiring attention.

It is very evident that a well-designed and well-constructed plant can be operated at a low figure per ton if of commercial size. The cost per ton, excluding depreciation and bond interest, certainly need not exceed 35c. per ton, and where wages are paid at a low rate need not exceed 25c. per ton.

Every important section of the plant is provided with recording thermometers, gages and meters, so that the management can ascertain at a glance how everything is operating. The results obtained from each and every double retort can be accurately ascertained.

#### Oil Seeds in India

In a recent letter from Trade Commissioner Batchelder he states that in normal years India produces well over 5,000,000 tons of oil seeds, worth about £50,000,000, one-third of which is usually exported. No other country produces such a variety, which includes cotton seed, rape seed, peanuts, sesame seed, mowra seed, poppy seed, niger seed, linseed and castor seed, as well as copra. Linseed, niger seed and poppy seed were formerly used in paints and varnishes as liquid drying oils, and rape seed was employed for industrial purposes, but linseed and rape seed can be refined for the production of margarine, and much rape seed is being used for this purpose on the Continent of Europe. Copra and mowra yield solid fats, while liquid non-drying oils are expressed from cotton, sesame, rape and castor seed, and from peanuts. India furnishes 98 per cent of the castor seed of the world, the oil from which is considered the best lubricant for airplane engines, and also supplies 100 per cent of the mowra, 100 per cent of the niger, 65 per cent of the rape and 76 per cent of the poppy seeds of the world.

#### Production of Coquito Nuts in Mexico

A recent report from Consul McConnico, Guadalajara, Mexico, states that the coquito palm grows abundantly in the States of Colima, Jalisco, Nayarit and Sinaloa, and that quite an industry has been established in gathering and preparing the small oil-bearing nuts for the market. The estimated annual production of these nuts in the district referred to above is 5,000 tons, valued at prices varying from \$150 to \$250 per ton. Ten years ago, before the value of the nut was really appreciated, the price did not exceed \$40 per ton. Soap manufacturers of Guadalajara and Mexico prize the nuts very highly because of the oily substances derived from them and consume practically the entire production in the manufacture of soap.

## The Dimensional Limitation of Successive Heat-Treatments of Carbon Steel

BY W. P. WOOD

WHILE concerned with the metallurgical inspection of aircraft engine parts, the following situation came many times to the writer's attention: Forged alloy steel parts, such as connecting rods, came from the heat-treating department to be inspected. The length and other dimensions were checked upon suitable gage blocks and the Brinell hardness was taken. Several of the pieces would be acceptable from the standpoint of dimensions, but would be too hard or too soft. These would be returned to be heat-treated a second time. This procedure might be repeated three or four times upon the same pieces. It was noted that after one or two such successive heat-treatments many of the pieces would have to be rejected on account of failure to fit the gage blocks; in other words, they had shrunk during the heat-treatments.

It seemed that if some information were available concerning the causes and amount of this shrinkage, much time and trouble might be saved. With this thought in mind, the present investigation was started.

Through some rather rough preliminary experiments it was demonstrated that this shrinkage is much more marked in some alloy steels than in carbon steels, but it was deemed best to study the carbon steels first, since the phenomena of their structure and treatment have been more thoroughly demonstrated.

#### PROCEDURE

Steels of the following carbon content were used: 0.11, 0.32, 0.44, 0.55, 0.64, 0.74, 0.82, 0.99 and 1.14 per cent. Manganese was in the neighborhood of 0.50 per cent and sulphur and phosphorus were both 0.05 per cent or below. Uniform samples 1 cm. square and 10 cm. long were machined from the annealed bar stock. Enough samples were prepared so that several checks could be run.

The length of each sample was carefully measured in a micrometer, the design and operation of which may readily be understood from the accompanying illustration Fig. 1. In making all measurements, the samples were always placed in the micrometer in the same position. The micrometer was frequently checked with a standard 10-cm. block.

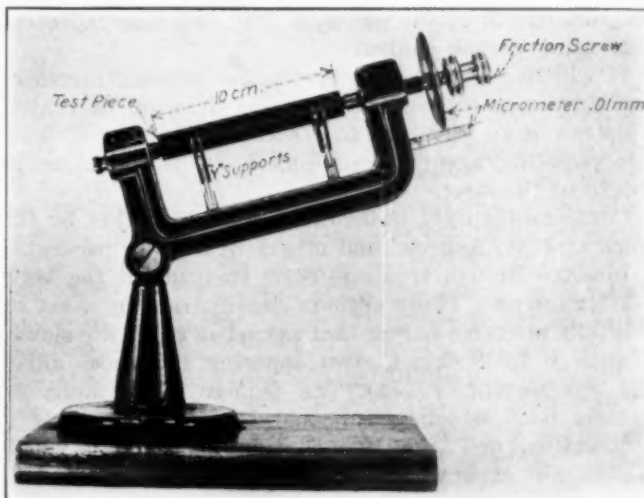


FIG. 1. MICROMETER AND FIXTURE FOR LENGTH

It was felt that more comparable results would be obtained if all samples were subjected to the same heat-treatment. The treatment selected was a hardening quench in oil from 900 deg. C., followed by a draw at 600 deg. C. The high drawing temperature was used in order to bring to a maximum all the possible effects which the draw might produce.

A Hoskins muffle furnace was used and a reducing atmosphere maintained by keeping a layer of charcoal about an inch thick over the floor of the furnace. Temperatures were measured by means of a millivoltmeter and a platinum thermocouple which was protected from the reducing atmosphere of the furnace by being inclosed in a fused silica tube. The samples were supported upon horizontal chromel wires and were placed parallel and close to thermocouple. After temperature had been reached, the pieces were allowed to soak for twenty minutes before removal from the furnace. After each hardening and drawing operation the length of the pieces was again measured. Almost no oxidation of the pieces was noted, although each had more or less "oil scale" upon it which was readily scraped off by a slight pressure with the blade of a knife or the finger nail.

Each sample was given three successive heat-treatments, a complete heat-treatment being the hardening quench and draw.

### RESULTS

The results are presented in the accompanying graph Fig. 2, representing the shrinkage due to the successive heat-treatments, plotted against carbon content. The zero line is placed in such a position that shrinkage may

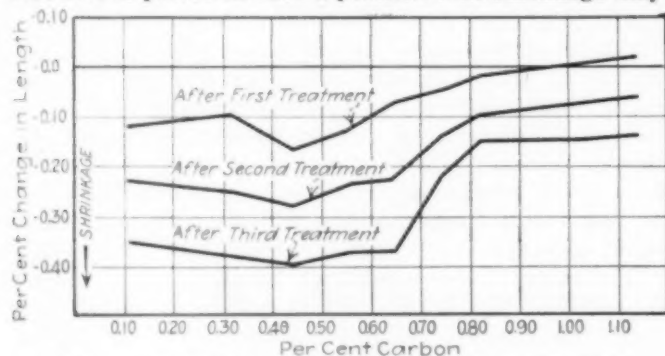


FIG. 2. CHANGE IN LENGTH AFTER REPEATED HEAT-TREATMENT

be plotted as a negative and expansion as a positive quantity. The ordinates represent percentage of the original length of the pieces, and the abscissæ represent increasing carbon content.

It will be noted that as the carbon content increases the shrinkage after hardening and drawing decreases. This condition leads one to the conclusion that at least two opposing agencies are influencing the changes in length of the steel.

Considerable light is thrown upon this subject by the work of J. H. Andrew<sup>1</sup> and others in a paper presented before the British Iron and Steel Institute at the May, 1920, meeting. These authors demonstrate by a set of skillfully prepared curves that as carbon steels are slowly heated to 1,000 deg. C. two opposing influences affect the steels—namely, (a) The change from alpha to gamma iron, which is in general of the nature of a contraction, and (b) the solution of carbide, which causes an expansion. As the per cent of carbon

increases, this so called "carbide expansion" increases. In steels carrying less than 0.70 per cent C the expansion is completed in the critical range. In steels carrying more than 0.70 per cent carbon this expansion continues above the critical range. It is concluded by the authors that this continued expansion is not altogether due to solution of carbides, but is continued by the dissociation of carbides in solution.

In the light of what has been said in the preceding paragraph, it may readily be perceived why high-carbon steels exhibit less change after hardening than low-carbon steels.

A glance at Fig. 2 reveals the fact that after the first complete heat-treatment the hypo-eutectoid steels were shorter than they were in the annealed state. The eutectoid steels had not changed much in length and the hypereutectoid steels showed slight dilatation. This condition was one that seemed logical when all of the circumstances were considered.

When a quenched steel is drawn one may presumably conclude that a reversal of all the effects occurring when the piece was first heated will tend to take place. In those steels which carry larger amounts of carbon and have undergone greater expansion we would not expect to find as great an amount of shrinkage relative to original length after a drawing operation.

Two possible reasons occur to the writer in explanation of the observed fact that the hypo-eutectoid steels were shorter after heat-treatment than in the original annealed state. One lies in the possibility that the cooling after annealing did not give as much time for the reversal of the "carbide expansion" as did the draw following the hardening quench. If this were true, the annealed pieces were in a slightly expanded condition when measured.

The second possibility lies in the more rapid contraction of the outer skin of a piece of steel when quenched. J. E. Stead<sup>2</sup> has mentioned an interesting instance of this in the case of a cylinder of steel which was subjected to many repeated quenchings. After a time the cylinder actually began to assume the shape of a sphere due to the more vigorous contraction of the outer portions of the piece. The length of the cylinder thus tended to decrease.

As a result of the second and third heat-treatments a rather uniform shrinkage in all the steels was noted, not so marked, however, in the case of the eutectoid and hypereutectoid steels. Here the most feasible explanation seemed to be the greater contraction of the outer portions of the specimen of steel during a quench as mentioned in the preceding paragraph.

In conclusion it may be said that the effect of heat-treatment upon the length of carbon steel sections is the result of three influences—the allotropic change in the iron, the solution and dissociation of the carbides and the more rapid contraction of the outer portions of steel objects upon quenching. The net result upon the length of the piece is the algebraic sum of changes in length caused by these three factors.

The hypo-eutectoid steels appear to shrink more rapidly than the others, and thus it would not seem advisable to repeat heat-treatments as often upon these steels as might be possible with precisely machined eutectoid and hypereutectoid steels.

Dept. of Chemical Engineering,  
University of Michigan,  
Ann Arbor, Mich.

<sup>1</sup>J. Iron & Steel Inst., vol. 161, p. 527.

<sup>2</sup>J. Iron & Steel Inst., vol. 83, p. 235.

## Manufacture of Synthetic Ammonia at Oppau, Germany\*—II

Catalysis of the Nitrogen-Hydrogen Mixture—Description of the Catalyzing Plant—Extraction of the Ammonia Formed—Description of the Ammonia Oxidation Plant and Its Operation—Description of the Absorption of the Nitrous Vapors Plant and Its Operation

THE research work of Le Chatelier and Haber has shown that the union of nitrogen with hydrogen is facilitated by an increase in pressure, whereas the increase in temperature lowers the proportion of the ammonia formed but increases the velocity of the reaction. The theoretical maximum of ammonia which can be obtained at 600 deg. C. under a pressure of 200 atm. is from 8 to 9 per cent. It is therefore necessary to absorb the ammonia as fast as it is formed while maintaining a continuous circulation of the gas. The Badische Anilin- und Soda-Fabrik accomplishes this by the use of water instead of by liquefaction of the ammonia, which proved to be costly and at the same time does not insure complete removal of the ammonia formed and also forms obstructions when the temperature falls below the melting point of ammonia. By the use of water as ammonia absorber some water vapor is introduced in the circuit and this eliminates the use of some catalyzers, but it has been proved that this moisture is practically without effect on the efficiency of catalyzers with iron as base.

The destructive action of the hydrogen on the walls of its recipients when the temperature is above 450 deg. C. and at high pressure has caused a series of difficulties and even accidents. It was therefore necessary to use special means for the manufacture of catalyzing apparatus. It would seem that under the above conditions of temperature and pressure the hydrogen diffuses through the metal and combines with the carbon of the steel, giving methane, thus producing blow-holes of appreciable sizes which weaken enormously the resistance of the metal.

### DESCRIPTION OF THE CATALYZING PLANT

The Oppau works has two catalyzing plants. The most recent one consists of fifteen separate chambers (Fig. 8) situated in one building, each having a catalyzer A, with its heat exchangers E, E'. The roofing is very light so as to minimize the damage in case of an explosion of the apparatus. A thick wall separates the chambers from the compartment containing a battery of ten circulating pumps P of a total power of 4,000 hp. driven by steam engines M, and, superposed at different levels, twenty-four dissolving tanks, eight coolers K and separators  $d_1, d_2, d_3$ .

The catalyzing apparatus (Figs. 9 and 10) is formed of a steel tube A, 12 m. high and 1.10 m. exterior diameter. It ends at each extremity by a flange and is closed by a steel cap B fixed with 9-cm. diameter bolts. The cap at the bottom is a truncated cone (16 deg.) which fits into a similar form at the extremity of the tube and is driven into its final position by a hydraulic press. The tube A, of 12 cm. wall thickness, has a series of holes from 1 to 5 mm. diameter spaced at regular intervals which serve probably for the escape of the diffused

hydrogen. It is lined with a similar tube C (Fig. 11) of soft steel about 2 cm. thick, whose extremities are hammered into the conical part and then the cap is fixed. A concentric steel tube D is separated from the tube C by a space of 1 to 2 cm. and kept in place by a series of wedges. It is through this empty space between the tubes C and D that the nitrogen required to counteract the diffusion of the hydrogen is supplied. The tube D is lined with a heavy refractory wall E formed of superposed cylinders, and finally the inner iron tube F, of heavy walls, which contains the catalytic mass. This is the constitution of the upper part only; the lower part of the apparatus constitutes a tubular heat regenerator.

The catalyzer is surrounded by an insulating envelope, leaving between them a small annular space in which cold air may circulate.

The two heat exchangers  $G_1$  and  $G_2$  (Fig. 9) placed near the catalyzers are 8 m. high, 0.90 m. exterior diameter and contain each from 130 to 140 tubes.

Each apparatus comprises also a circulating pump of 0.6-m. stroke, 0.4-m. cylinder diameter driven by a 750-hp. steam engine.

At the outlet of the regenerators the catalyzed gases are brought to the ordinary temperature by eight cool-

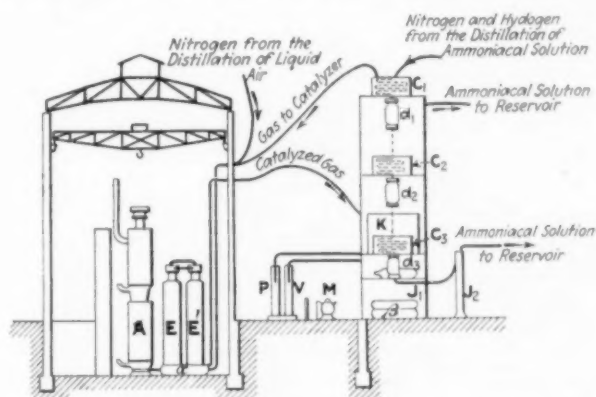


FIG. 8. SCHEMATIC ARRANGEMENT FOR THE CATALYSIS OF  $N + H_2$

ers K (Fig. 8), each one being formed of twelve to sixteen series of five tubes 7 m. long, 7 cm. diameter, connected in parallel to parallelepipedic collectors of 12-cm. sides, the whole being inclosed in a sheet-iron vat in which circulates a rapid stream of cold water. The condensed water is collected in horizontal cylinders  $J_1$ . From the coolers the gases enter dissolving columns, each of which consists of three vats  $C_1, C_2, C_3$  (Fig. 8) with pipe coils. These vats are superposed and spaced from 6 to 7 m. apart. They are connected to the vertical cylinders  $d_1, d_2, d_3$ , in which the liquid separates from the gas. The capacity of these separators is 200 liters.

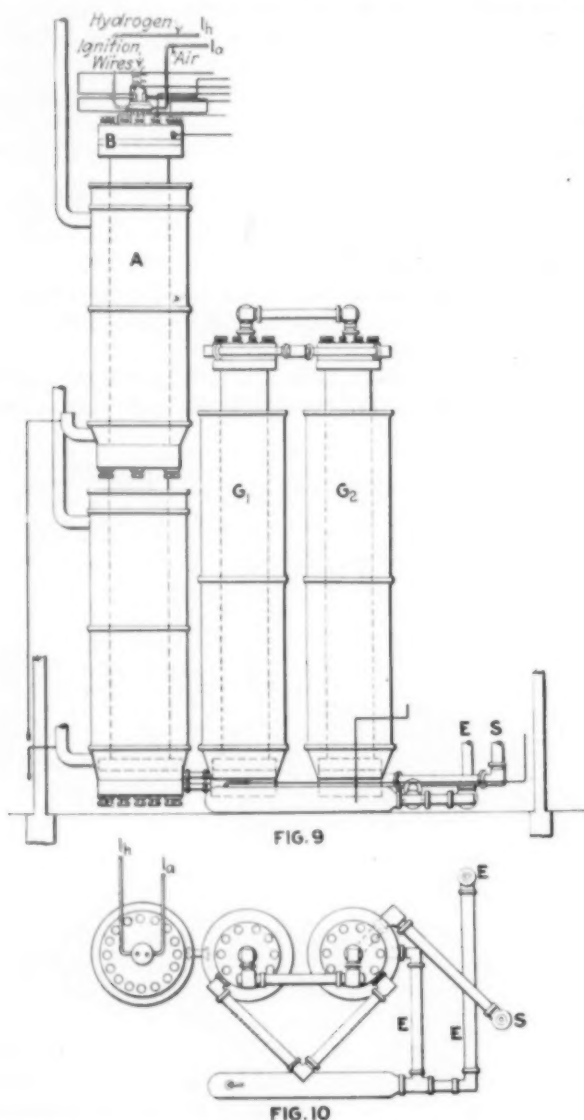
The vats are 1.8 m. high, 3.5 m. diameter and contain twelve concentric steel coils of 5 cm. diameter of the same length and whose corresponding extremities are

\*From *La Technique Moderne*, November, 1920, pp. 449-460.  
For Part I see *CHEMICAL & METALLURGICAL ENGINEERING*, vol. 24, No. 7, p. 305, Feb. 16, 1921.

fixed to a manifold, the lower part of which is connected to a separator. The vat contains the cooling water. The dissolving water, compressed to 200 atm., is divided as uniformly as possible for each of the coils. Indicators permit observation of the liquid stream entering each coil. This water circulates from vat to vat, starting at the top, the separator of each vat being connected to the top of the coil in the vat immediately below. The solution leaving the last separator enters the receivers  $J_2$ .

These receivers are provided with indicators which show when the level of the liquid reaches the maximum. A series of valves permits the emptying of the liquid with successive expansions into closed reservoirs of about 20-cu.m. capacity, these reservoirs being designed to resist internal pressures of from 2 to 3 kg. Nitrogen and hydrogen, which dissolve along with the ammonia, are recovered from these reservoirs and sent back to the gas holder for the mixture  $N_2 + H_2 + CO_2$ .

The operations are controlled by a series of measur-



FIGS. 9 AND 10. ARRANGEMENT OF THE CATALYZERS AND HEAT EXCHANGERS

ing apparatus—namely, thermocouples, measuring burettes, registering apparatus for hydrogen content (based on the velocity of diffusion of the gas through a very small orifice), registering manometers, Bosch balances and registering apparatus for the velocity of the gaseous currents.

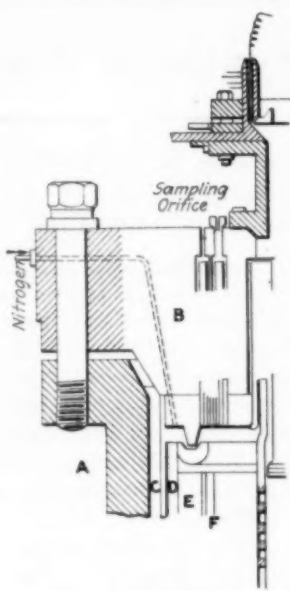


FIG. 11. DETAIL OF TOP OF CATALYZER

and hydrogen. The gases of the blowpipe are injected at a pressure of 200 atm. The ignition is produced by a platinum wire maintained at red heat to produce the union of oxygen and hydrogen in case the first of these gases should accidentally reach the blowpipe.

About 18,000 cu.m. of the gaseous mixture passes each furnace per hour, producing about 20 g. of ammonia per twenty-four hours.

The difference in pressure of the gas between the inlet and outlet from the circulating pumps is generally between 4 and 5 atm. and was never higher than 15 atm. The temperature of the gases at the outlet from the heat regenerators is between 140 and 150 deg. C. The ammoniacal solution contains about 25 per cent ammonia.

#### EXTRACTION OF THE AMMONIA

The ammoniacal solution is pumped by a centrifugal pump through a meter and into a 2,500-cu.m. reservoir. From the reservoir the liquor enters at *a* (Fig. 12) the heat exchanger *R*, thence through *b* to the top of the tower *A*. This tower is 2 m. diameter, 10 m. high and well insulated. Steam is injected at the lower part of the tower at *c*. The liberated gas and the steam pass through a cooler located on top of the tower. This cooler contains 525 horizontal tubes of 8 mm. diameter through which cold water circulates. The ammonia escapes through pipe *d* into a collector *D* which is common to all the twenty-four towers in the building and thence to a 12,000-cu.m. gas holder which contains water covered with a layer of oil to retard the saturation with ammonia. The water of solution and the condensed vapor, which now contains only less than 0.0005 ammonia, leaves through *f* at the lower part of the tower and passes through the regenerator *R*, whence a part goes through *g* to the dissolving apparatus and the other part to the boilers.

#### DESCRIPTION OF THE AMMONIA OXIDATION PLANT, AND ITS OPERATION

The Badische Anilin- und Soda-Fabrik oxidizes the ammonia by a catalytic mass which appears to be a mixture of oxides of iron, manganese and chromium agglomerated with bismuth chloride.

There are two oxidation buildings. The newer one

consists of three groups of two Rateau ventilators direct-connected to a 200-hp. steam turbine. The ventilators are of different sizes. The smaller ventilator of each of the groups circulates 36.8 cu.m. ammonia per minute, the larger ventilator brings in 46.6 cu.m. filtered air per minute. The three groups send their gases into a 2-m. diameter 10-m. long horizontal cylinder located underground and in which the mixture takes place. From this reservoir the gas mixture arrives through pipings *a* (Fig. 13) to eight regenerators and thence to sixteen oxidation furnaces *B* placed in two rows along the building. The oxidized gases enter the tubes of eight waste heat boilers (not shown in Fig. 12). A series of sixteen gas furnaces *C* serve for the heating of the oxidation furnaces.

The catalyzing apparatus grouped by twos consist of cylinders 3.5 m. external diameter and 5.5 m. high. They are well insulated. The upper part of the cylinder is closed by a brick top provided with a central opening *c* for the escape of the heating gas. A brick partition divides the chamber into two nearly equal parts. This partition is plane and horizontal at the top part and spherical at the bottom part. It is provided with 15-mm. holes spaced at about 8 cm. centerlines. These holes are slightly closed. The contact mass in sizes of 5 to 8 mm. is placed over this partition in a uniform layer of about 5-cm. thickness. The oxidized gases after leav-

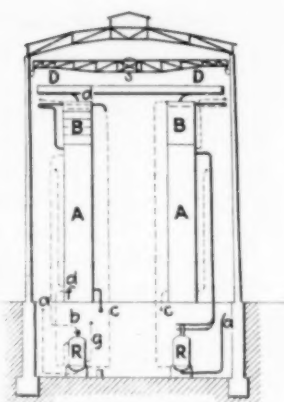


FIG. 12. SCHEMATIC ARRANGEMENT OF EXTRACTION OF AMMONIA

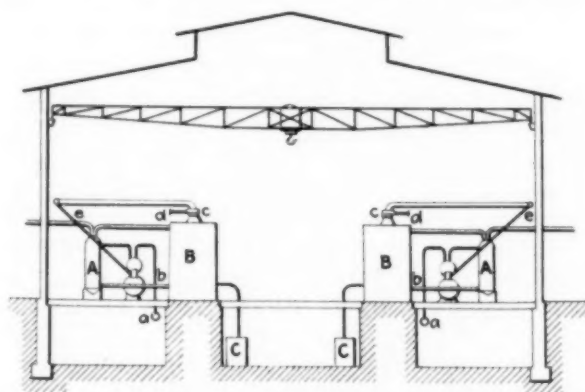


FIG. 13. SCHEMATIC ARRANGEMENT OF THE INSTALLATIONS FOR THE CATALYTIC OXIDATION OF AMMONIA

ing the regenerators are received into condensation towers.

The operation is kept under control by:

Peep-holes which permit observation of the catalytic mass, which is to be maintained at red heat.

Thermocouples giving the temperatures at different points (inlet and outlet of regenerators, inlet to boilers.)

Recording velocity indicators of the gaseous currents and manometers.

Gas-testing apparatus at inlet and outlet.

When the temperature tends to exceed the desired value a bypass valve brings in a part of gas which does not pass through the heat exchanger. This addition is made through piping *e*. If the mixture has not the

desired composition, the required amount of air or ammonia is added.

Each furnace oxidizes about four tons of ammonia per day with an efficiency of 80 per cent. The duration of contact is about one-half second.

At the Oppau plant from 180 to 200 tons of ammonia could be oxidized per day, but it would seem that at present only eighty tons per day is oxidized.

#### ABSORPTION OF NITROUS VAPORS

The nitrous vapors obtained by oxidation of the ammonia are absorbed by water, giving a 50 per cent solution of nitric acid, or by a sodium carbonate solution, giving a mixture of nitrate and nitrite of sodium.

The plant contains five stone or brick towers (I, II, III, IV and V, Fig. 14) and two brick columns (VI and VII) lined outside with sheet iron.

The gases arrive in tower I. This tower has a decag-

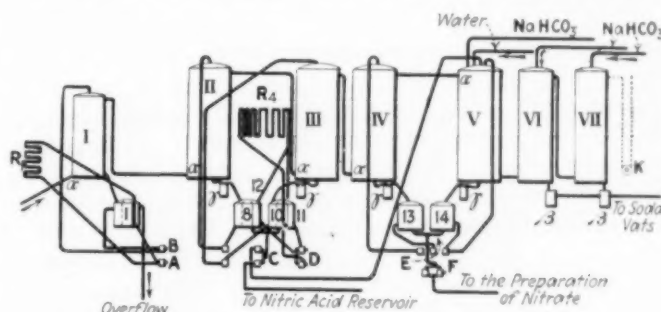


FIG. 14. SCHEMATIC ARRANGEMENT FOR THE ABSORPTION OF NITROUS VAPORS

onal section 5 m. in diameter and 15 m. high. Towers II and III are cylindrical, 7 m. in diameter and 20 m. high; towers IV and V have a decagonal section 6 m. in diameter and 20 m. high. All these towers are lined inside with 20-cm. thick acid-proof layers. The two columns VI and VII are used for the circulation of soda solution. The towers and the columns are filled with Raschig rings and stand on foundations 5 ft. high.

There are three towers I, to which correspond six reservoirs (1 to 6) 2.5 m. in diameter and 4 m. high. Between the towers II and III, IV and V there are also six reservoirs (7 to 12 and 13 to 18). These twelve reservoirs are 3.5 m. in diameter and 4 m. high. All the reservoirs are of brick, tarred inside and connected by stoneware piping. In the piping of the last four towers there are stoneware valves for sampling the liquors. All the pipes leading to towers of the same order are connected to a horizontal manifold. A stoneware overflow pipe is provided for each reservoir and the overflow escapes through underground channels.

The circulation of the acids is maintained by centrifugal pumps made of a 15 to 18 per cent Si pig iron called Elianite, and which are driven by electric motors.

There are two groups of two pumps A and B (Fig. 14) for the three towers I, a group of four pumps C and one group of two pumps D for the towers II and III, a group of four pumps E and one group of two pumps F for the towers IV and V.

The circulation of the sodium carbonate and nitrate solutions is made by two groups of two pumps driven by 110-kw. motors.

Other pumps serve for the circulation of cold water, warm water or soda solutions to the top of tower V.

The solution of filtered nitrates is sent to the reservoirs by six pumps. Two pumps collect the solutions of nitrate and carbonate spilled on the floor of the build-

ings and send it to the reservoirs. A ventilator driven by a 130-kw. motor is placed on the outlet piping for gases, and two others serve to send air into the pipings bringing in the nitrous vapors.

All these pumps and ventilators absorb a total of 2,000 kw.

The acid collected at the bottom of the towers I, II and III is cooled in refrigerators *R*. These refrigerators are composed of thirty-six horizontal tubes connected in three groups and cooled by cold water sprays.

The gas arriving at the lower part of the towers I at *a* leaves at the top, enters the towers II at the lower part, and so on up to towers IV, whence the gases enter the towers V at the upper part.

The pipings of the towers III are connected to a single horizontal pipe which permits to bypass any one tower of the last three groups.

In the soda columns the gases enter at the lower part and leave at the upper part.

In the towers I, in which the temperature is about 50 deg. C., the acid obtained is of 35 per cent concentration; in the towers II the temperature is about 40 deg. C. and the acid is of 40 to 50 per cent concentration; in the towers III the temperature is 35 deg. and the acid is of 25 per cent concentration. The towers IV and V are at a temperature approaching the atmospheric temperature and they contain a diluted acid which is used for the production of sodium nitrate. Eighty per cent of the oxides of nitrogen is transformed into acid, 15 to 16 per cent into nitrates and 4 to 5 per cent is lost. The daily production of nitric acid would be about 264 tons.

Sulphuric acid is used for the concentration of the nitric acid in six cylindrical columns 10 m. high. These columns are steam heated. Two of the columns are of stone; the others, of more recent construction, are built of sectional Elianite tubes 75 cm. long, 1 m. in diameter, 4 cm. thick, connected by conical joints. These columns are provided with loosely laid Raschig rings. Sulphuric acid enters at the top of the column, nitric acid is supplied by two tubes entering the column respectively at 2 m. and 3 m. from the top of the column. Steam enters at the bottom in the center. The concentrated nitric acid vapors leave at the top of the column through Elianite pipes and enter the water-spray-cooled refrigerators. The condensed acid is collected in a reservoir. The non-condensed vapors are led by stoneware pipes to the nitrification towers described above.

The sulphuric acid is denitrated in columns analogous to those for concentration but only 6 m. high.

The denitrated acid passes through tubular coolers, and enters two lead-lined vats 4 m. high and 5 m. in diameter provided with seven cooling coils and thence to eight Kessler concentration apparatus 4.5 m. long, 3 m. wide and 1 m. high. These are heated with Kraftgas.

The nitration of sodium carbonate takes place principally in vats 3 m. in diameter, 2.5 m. deep, lined inside with brick and provided with wooden agitators. The carbonate solution used in these vats comes from a special dissolving building or from the Solvay soda plant. The acid vapors are brought in by three pipes.

The nitrous and nitric vapors liberated in the reaction are led to the bottom of column VI. The nitrate-nitrite solution after filtration is collected in three reservoirs 10 m. high and 3.5 m. in diameter.

*(Part III, the last, will be published in a subsequent issue.)*

### Condition of the German Sugar Industry at Close of 1920

Germany is confronted with the problem of increasing its sugar production to meet domestic needs, reports Howard W. Adams, representative of the Department of Commerce, Berlin. In the sugar-production year 1919-20 there was a total of 269 sugar-beet mills in operation in Germany, as against 307 for 1918-19. Since the latter period thirty of the 307 mills referred to passed out of German jurisdiction along with those territories transferred from Germany under the treaty of Versailles.

#### SUGAR-BEET PRODUCTION IN 1919-20 SHOWS LOWEST AVERAGE FOR MANY YEARS

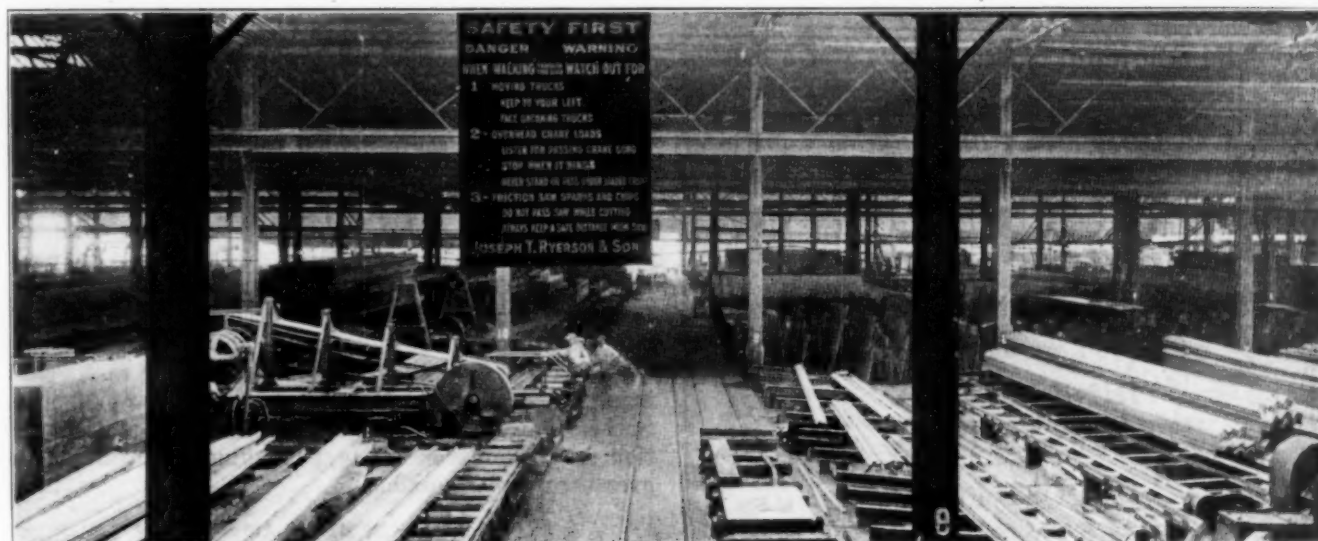
The sugar-beet production in Germany during the period 1919-20 attained an average of only 19 metric tons per hectare (hectare = 2.47 acres), the lowest average for many years. This diminished production is ascribed in part to the bad weather conditions existing at the time of planting and to the inadequate cultivation of the crops, due to the lack of labor and strikes. The first examination of the plants disclosed the fact that the average weight of the root was only 88 g., as compared with the preceding year's weight of 173 g., and a sugar content of 11.7 per cent, as against 12.4 per cent for the preceding year. The final examination of the plants showed a somewhat increased average sugar content, but considerably smaller beets—namely, 342 g. weight and 20.9 per cent sugar content, as against 504 g. and 19.8 per cent, respectively, for the year previous. Then a further setback to production occurred in the form of frost, which set in just at harvest time and as a result prolonged the work of completing the harvest with an accompanying heavy loss in sugar.

#### DOMESTIC PRODUCTION INADEQUATE TO GERMANY'S NEEDS

The net sugar production for 1919-20 amounted to a total, in round numbers, of 733,000 tons of raw sugar, as compared with 1,346,000 tons produced in the preceding year. Consequently, the domestic production was inadequate to meet the country's needs, which during the preceding year amounted to about 1,000,000 tons. It therefore became necessary for Germany to import 57,000 tons of sugar, as compared with the 29,000 tons imported during the preceding year. The only thing that saved Germany from a heavier importation during the 1919-20 period was the supply of 216,000 tons which became available from the stocks of the preceding year.

#### CONDITIONS PROPITIOUS FOR DEVELOPING CULTIVATION AND INCREASING PRODUCTION

At the beginning of the new sugar year Germany finds itself without available stocks of this commodity on hand. There is felt more than ever the pressing need of developing the sugar-beet cultivation and increasing production as far as possible. Conditions appear to be propitious for such a result. The cultivable acreage shows a slight increase—4 per cent—over that of the preceding year, and the fields are reported to be in good condition. The question remains as to whether the sugar mills will receive supplies of coal adequate to their needs and whether strikes among the farm laborers will disturb cultivation.



## Safety Methods Applied in the Ryerson Steel-Service Plants

**An Outline of the General Organization for Safety Promotion in the Plants and of the Results Leading to Better Relationship Between Management and Workers and to Ultimate Reduction of Plant Operating Costs and Higher Efficiency**

THE prevention of accidents is an essential function of modern industrial management. Safety means not only a humanitarian movement, but goes far toward a better relationship between management and workers, and it has a direct influence on the cost of production.

Even though there were no material benefits to be derived from the prevention of accidents, it would still be desirable for industry to put forth a powerful effort in the elimination of hazards. But the practical results of a continuous, concentrated safety campaign are so evident that the work is also well warranted on a basis of dollars and cents.

The Joseph T. Ryerson & Son plants inaugurated intensive safety work six years ago because the management appreciated the opportunity to protect its workers, and the same impulse continues to keep the interest keen. These efforts have had ample reward.

Safety promotion means not merely the showing of bulletins and the soliciting of suggestions. To be really successful, it demands a more vital interest on the part of the entire working force.

### ENTHUSIASM ESSENTIAL

The secret of success in safety promotion is the maintenance of eternal interest and enthusiasm. Enthusiasm cannot be instilled satisfactorily by merely forming an organization or by providing a system for handling suggestions. To be enthusiastic, a man first of all must believe in the thing heart and soul. If a workman does not really understand and sympathize with accident prevention, no amount of bulletin boards or "safety sermons" will have any effect on him. He must be sold just as thoroughly as must a purchasing agent when considering a new product. Furthermore, he has got to have the goods delivered to him in the style which he

can understand. This requires many different forms of activities and constant resourcefulness in treating with the individual.

Safety work without organization is as ineffective as in any project without a method of operating. Just as we need a production man to plan the routing of work through our shop, so also do we need a man to be responsible for accident prevention.

Committee meetings are excellent in promoting a general familiarity and team work among the men, but safety meetings that lack real interest are worse than useless.

Talking with each man individually every day is impossible in a large plant, but an efficient substitute can be gained by providing bulletin boards that carry a daily message to the workman. Bulletin boards to



THE FIRST-AID ROOM

talk to workmen must say something, and say it with a punch. No man will take time to pore over a bulletin which is ambiguous, or too lengthy. Snappy and clear cut items on a neat appearing bulletin board never fail to attract attention. The following is an example of such bulletins:

## NOTICE

TO ALL MEN SEEKING EMPLOYMENT

If you are unwilling to

THINK "SAFETY"

WORK "SAFELY"

and

BOOST FOR

"SAFETY ALWAYS"

You Should Not Ask For Employment Here  
WE HIRE SAFE MEN ONLY

— IF EMPLOYED —

be sure to get a Safety Rule Book at once. You should read it carefully, and in your work abide by all its regulations. You will be expected to read regularly the Safety Bulletins and to promote Safety-Always-Everywhere.

This sign is placed at the entrance of our employment department where all prospective employees are bound to read it.

### COMPETITION EFFECTIVE

Among all these essential measures, however, none compares with the use of the competitive spirit. Why not utilize one of the best traits in human nature? It is what causes men to strive for higher goals in every kind of endeavor. In safety work it is just as strong an incentive. Many workmen have been known to treat lightly the consideration of safety when the only incentive was the prevention of accident to themselves. But place those same men in a contest with others, competing for the safety record, and you have a different story. They are eager and watchful. They themselves not only are careful but they are quick to discipline a fellow worker if he fails to play the game.

All the foregoing are intended for the most part to arouse interest, to maintain enthusiasm.

Most of the real constructive steps are taken through the system for receiving suggestions and for making periodical inspections.

### A STRONG ORGANIZATION

The first step taken for the elimination of accidents was the creation of an organization that would be responsible for the carrying on of the work. Operating men who are busily engaged in directing the Ryerson steel-service plants have ex-officio positions on the committees, but are not held directly responsible for the carrying on of the campaign. Betterment department men, whose duties in other lines are entirely consulting, are chairman of the various committees and take the initiative in planning innovations and are responsible for the maintenance of continual interest in the work. Each plant has its own officers and full committee so that direct action can be taken on suggestions, and so that

local meetings can be held as frequently as desired. All are, however, co-ordinated by an inter-plant executive committee, the chairman of which is responsible to the vice-president of the company. This committee inaugurates inter-plant contests and makes it possible for the various local plants to make use of the ideas developed by the central committee, as well as by the other plants.

An interesting feature of the Ryerson safety organization is the provision for rotating the workman members of the plant committees. They are selected monthly, and the number of men on each plant committee is so calculated that every man in each plant has his turn at least once a year. Changing the committees once each month brings new energy and interest into the organization. Successful safety work requires inspiration and inspiration from plant men can best be gained by utilizing the greatest number possible.

### BULLETIN BOARDS

A few fundamental rules govern the handling of the Ryerson bulletin boards:

1. They are placed in positions about the plant where men—because of necessity or habit—most frequently congregate. Very often the mistake is made of placing the board in an obscure corner of the factory, and then expecting the workman to go to it. Newspapers are sold because aggressive newsboys bring the papers to your very hand. If the daily papers expected their patrons to walk to a central point to secure the morning sheet their sales would fall off appreciably. Likewise with the safety bulletin board. We are selling the workman a daily news sheet on "safety," and we have got to bring it to his attention, and not expect him to take the initiative in hunting it up.

2. One person should be responsible for the placing of bulletins on the board. If there is no such rule in

THIS CHILD IS HAPPY



SHE IS LOOKING FOR DADDY  
TO COME HOME SAFE AND SOUND

J. T. RYERSON & SONS, CHICAGO

### AN APPEAL TO HOME INSTINCTS

the factory and any one feels free to post whatever seems to him appropriate, the result is the same as would be the appearance of a newspaper which was edited by its entire reportorial staff. The Ryerson bulletin boards are in charge of one individual in each plant, who alone can unlock them and who alone is responsible for their appearance.

3. Interest travels in cycles, and accordingly that which attracts a man one day palls on him the next. Bulletin boards are changed daily, so that every morning



BATTERY OF SHEET SHEARS SHOWING GEAR GUARDS

the worker entering upon his job has before him a fresh thought on safety. Sometimes a very good bulletin can be posted a second time after a lapse of several months. But to allow the bulletin board to remain unchanged for several succeeding days is likely to mar the whole safety program. A man finally concludes that there is nothing to interest him on the board and therefore decides not to bother looking at it again. He has then got to be sold all over again, as far as his interest in reading safety bulletins is concerned, before he becomes what is desired—a habitual daily reader of the safety bulletin board.

4. "What kinds of bulletins do the work?" is a frequent query. Every plant is different, of course, in the type of men employed and accordingly in the language which must be used in pointing out hazards. Years of experience have taught the Ryerson safety organization a few fundamental rules in the preparation of safety bulletins. They should not be long or ambiguous. They should have a definite point. Wherever possible they should be illustrated with a photograph, or a magazine clipping, or with an exhibit such as a broken goggle, a worn-out glove, etc. They should cover subjects which are recognized by the men as directly affecting their own working conditions as far as possible.

An interesting and very effective way of determining the relative value of different types of safety bulletins, as well as of stimulating general interest, is by holding a preference vote. The Ryerson plant safety committee men have posted before them different types of safety bulletins. Arguments for and against the different types are heard from the various members, and a vote is then taken as to the prize bulletin submitted.

#### SUGGESTIONS ADD INTEREST

One of the most effective ways of stimulating interest in safety work lies in the encouragement of suggestions from the workman. Men take a natural pride in seeing their own suggestions put into effect. The Ryerson safety organization makes it a point to welcome all suggestions and also to put them into effect, if they are at all practical. Many times the interest that is created through the approval of safety suggestions is of even more value than the actual result of the improvement itself.

It has been found that men hesitate to place the suggestion in a box such as is usually provided. Not being able to see whether there are any other suggestions therein or whether or not they are ever removed, their interest will naturally lag. Glass bowls with red lights

in the background have been provided for the receipt of safety suggestions from Ryerson workmen. These bowls are emptied daily, and it has been found that the sight of even one suggestion in the glass bowl has prompted others to present theirs, where otherwise they might have never given the matter a thought.

#### LIVE SAFETY MEETINGS

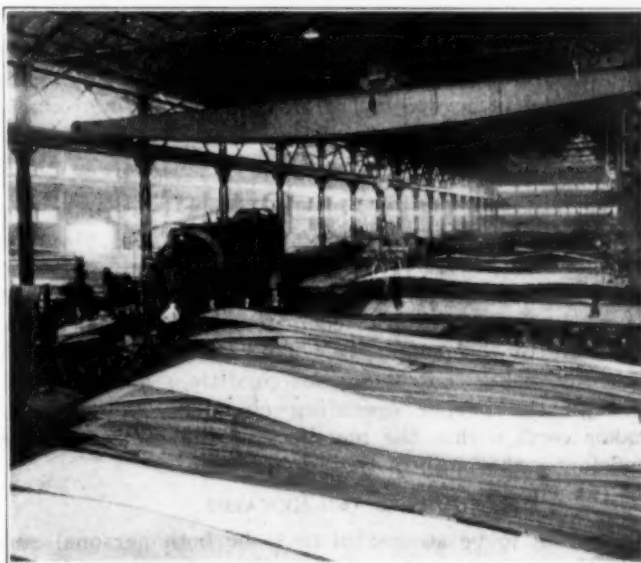
The holding of safety meetings is a good deal like the conduct of a political gathering or of any other congregation where it is the object to interest the audience in a specific issue. It is frequently found desirable to include on the program a number of features which, although entirely irrelevant to the subject at hand, have nevertheless an interest which holds the meeting together and arouses enthusiasm. That is why political campaigners like to visit state fairs. The crowd is there to hear and see what really interests them, and incidentally the campaigners get their opportunity.

The safety meeting is advertised in advance. Bulletins posted on the various boards announce perhaps the fact that a fellow workman is billed to talk on "How to Make the Assembling of Sheets Safer." It is suggested in the bulletin that every man ask his foreman for permission to attend the meeting. Of course, it is impossible for every man to be allowed to attend such a meeting, but the object is gained thereby of arousing indirectly an interest in safety by instilling a desire in every workman's mind.

Every man is probably surprised to learn that Bill Jones, his fellow workman, has agreed to stand before them and discuss "Safety." Their curiosity is aroused. They are anxious to know how Bill got the nerve and also whether he can "put it across." The idea of securing a lesson in safety probably never occurs to a single man, because each is far more interested in how Bill Jones is going to deliver.

Nevertheless, in the meeting there is going to be a lesson in safety. That will be assured in advance by those in charge of the meeting. And so, without hardly realizing it, all who attend the gathering will receive a bit of experience or an item of knowledge that will react toward the promotion of safety.

There is a general inclination among all men to dislike being preached to. They do not of their own free



HUGE PLATE SHEAR SHOWING GEAR GUARDS AND CAREFUL METHOD OF PILING STOCK



HIGH-SPEED FRICTION SAW OPERATED WITH SAFEGUARDS AND BY SAFETY RULES

will attend meetings where they suspect that they are going to be "talked to." However, a sermon can be presented indirectly sometimes in the form of a suggestion. And much easier than that can be the presentation of a thought on safety in an indirect manner. Give a man the nucleus of an idea, the foundation on which the thought is based, and he will make the proper decision himself. He likes to do that, and when a man believes he has made his own decision he is jealous of it, he champions it against all odds. That is the ideal condition in which to have the workman's mind in regard to safety.

A man who has made up his own mind that safety is a fine thing is worth ten who believe it simply because they think it is a good policy to do so.

#### PLANT COMMITTEE MEETINGS

At least once each month each plant committee holds a meeting at which it discusses reports, inspections, suggestions, accidents and other routine occurrences. These are called the routine committee meetings. Also once a month another meeting is held, such as we have described, to be attended by a considerable portion of the plant men and where no routine matter is taken up, where the sole object is inspiration for safety.

When we state that these meetings also result in co-operation, in good fellowship and in an excellent understanding, we merely express the obvious. The main purpose is the promotion of safety, but the byproducts are also very much worth while.

#### REGULAR AND FREQUENT INSPECTION

The backbone of accident prevention is regular and frequent inspection. Every stock room and piece of equipment in the Ryerson plants is inspected once each week by members of the plant committee. A detailed report on the condition of each item is submitted to the chairman of the committee. This chairman is responsible for seeing that dangerous conditions are remedied through the proper operating channels, and he also makes certain that the members of the committee are sufficiently thorough in their inspection.

#### PRIZES AND REWARDS

Contests to be successful must be both personal and collective. They must be personal in order to provide an incentive for each individual, and they must be collective in order to insure proper team work.

The plants, although scattered at widely different points, in Chicago, New York, St. Louis, Detroit and Buffalo, are nevertheless tied together by a closely knit organization, and a healthy and friendly rivalry in everything that makes for better service and working conditions. They compete with one another in safety with the same ardor that they show for greater steel tonnages and speed in shipment.

The plant which at the end of six months has the highest percentage standard is considered the prize winner, and every man in that plant, eligible through length of service, receives a reward in cash. Individual workmen in other plants are not neglected, however, if they themselves have a perfect score, even though their plant may fall down. Individuals maintaining perfect records for themselves throughout the contest period also receive a cash reward. It is a fact that a large majority in all plants earn their individual perfect record rewards.

Although the foremen should not be held entirely responsible for the conduct of the safety movement, nevertheless their influence in promoting the work should be clearly recognized. A foreman can be a hindrance to aggressive safety campaigning, even though not actively in opposition, by being merely passive in his enthusiasm. On the other hand, he can give a tremendous impetus to the prevention of accidents.

The foremen are encouraged to aid in every way in promoting safety, and are given a practical incentive for so doing. Every month the foreman whose department is leading in the contest receives a cash prize. Not alone is it the money reward which spurs the foreman to accomplishment in the safety campaign, but the natural desire to maintain his plant in the lead over other plants is an even greater incentive.

#### VARIOUS SAFEGUARDS

Various safeguards installed in the plants mutely testify to the low accident rate prevalent and to the ever lessening likelihood of workmen becoming injured.

Safeguards are not limited to any one class of machines or conditions. Sometimes the most dangerous appearing machines are the ones which do not require safeguarding as much as other conditions where danger is less obvious. For instance, the condition of floors, ramps and stairways is a common hazard which is very often overlooked, and accidents resulting from slipping and tripping or falling are taken as a matter of course. Safeguarding workmen from accidents of this kind is nevertheless just as important as protecting machinery, because the hazard in most cases is presented to a greater number of men. Safeguarded machines protect few men; safeguarded stairways protect the entire working force.

The Ryerson organization has met the situation by adopting the very best anti-slip material for stairways, ramps and slippery floors.

#### THE RESULT—SAFE PLANTS

The experience of an organization which for years has conducted an intensive promotion of safety means more perhaps to such a company than do the arguments of the safety campaigners.

It is difficult to determine the decrease in accidents in an organization which is growing and extending as fast as the Ryerson company; however, figuring conservatively from the yearly accident statistics, the accident rate has been reduced 80 per cent and even better is expected.

---

## Legal Notes

---

BY WELLINGTON GUSTIN

### Rights to Trade Mark Between Manufacturer and Distributor

A question of trade mark rights was decided by the Court of Appeals of Maryland in a suit brought by Corkran, Hill & Co., against the A. H. Kuhlemann Co. of Baltimore. The trade mark was known as the "Orange Brand" and had been used by the first-named company for many years covering meat products. In 1910 the company began to sell oleomargarine products, buying such from the Kuhlemann company. It furnished at its own expense the labels for such product, employing the words "Orange Brand," and stated thereon, in obedience to a requirement of the Government, the place where such article was manufactured. No oleomargarine product bearing this trade mark was sold by the Kuhlemann company to any one else. This course of dealing continued down to 1914. From 1914 to 1916 the plaintiff used the trade mark slightly changed, it being the same in design as that registered in the Patent Office in 1908. In 1916 the contract between the parties was more general, in which labels were used showing the Kuhlemann company manufacturer of the "Orange Brand" and Corkran, Hill & Co., as distributors. In this same year the Kuhlemann company, without the knowledge and consent of the other, had registered in its name the "Orange Brand" trade mark for manufacture and sale of oleomargarine. Upon discovery of this proceeding Corkran, Hill & Co. demanded surrender or abandonment of such trade mark, and instituted this suit. The trial court decided against Corkran, Hill & Co.'s claims and dismissed the case, but on appeal the Court of Appeals has reversed the lower court.

It was said to be unnecessary, to entitle the claimant to the use of a trade mark, that it should have been the manufacturer of the article. Neither was it necessary that the trade mark should have been registered to entitle plaintiff, the claimant, to use of trade mark, or to protect the company and its work against infringement.

The facts showed that Corkran, Hill & Co., or its predecessor, designed, adopted and used the "Orange Brand" trade mark, and thereby acquired exclusive right to its use. This right persists unless abandoned or acquiesced in its use by the defendant. The court said an abandonment is the voluntary and intentional disuse or non-use of the trade mark. Such intention may be inferred from circumstances necessarily pointing to an intention to abandon, but an actual intention to give up permanently the use of the trade mark is necessary to constitute an abandonment of it. Mere disuse, though for a considerable period, in the absence of intentional abandonment will not amount to an abandonment, nor will it destroy trade mark rights, unless the mark has ceased to be distinctive and the good will associated with it has passed away, or the mark has become identified with other goods.

Finally, it was said where the manufacturer was permitted to use the trade mark for goods put up for the

distributor, there was no abandonment of the mark by the distributor, nor was the right to use it lost by such distributor on account of its acquiescence in the use by the manufacturer for their mutual benefit.

A permanent injunction therefore was awarded to Corkran, Hill & Co.

### Contract to Buy May Not Be Transferred Without Consent of Original Seller

Litigation between the Phosphate Mining Co. and the Atlanta Oil & Fertilizer Co. has occupied the courts for several years over a contract of the latter to accept and pay for phosphate rock mined by the former. The latest decision in the matter is that of the Court of Appeals of Georgia (103 S. E., 873) affirming the trial court. The two questions presented the jury were the "rule of avoidable consequences" and "whether the seller had in fact consented to the transfer of the contract."

It appears that the Atlanta company transferred its purchase contract to the Empire Cotton Oil Co. and contended that because of such transfer it was not liable under the contract.

The court instructed that if the transfer was made to the Empire company and the Phosphate Mining Co. accepted the transfer, the Atlanta company was relieved of further liability but the Empire company would assume such obligation that might arise out of the contract. The Atlanta company would be relieved either by express contract or by implication having notice of the transfer and accepting it. The jury found there was no notice and acceptance of the transfer of the contract by the seller, Phosphate Mining Co.

The action being one for damages for the buyer's breach of written contract to accept and pay for phosphate rock, a charge to the jury, on the issue of damages and the avoidance of consequences, that, if the buyer breached the contract, the seller might recover the difference between the market value and the contract price for the rock, was not erroneous as ignoring the defense by the buyer's transfer of the contract to another company and the seller's duty to minimize the damages after its acceptance of such transfer.

The contract provided:

"Buyers are at liberty to diminish the quantity called for in any year to the extent of not exceeding 10 per cent, provided that the quantity to be taken shall not be less than buyer's consumption, and provided further that notice of such diminished demand be given seller twelve months in advance of such change."

The seller was notified that the buyer had no demand for consumption and had no capacity for consumption after July 1, 1912, and had sold out its plant and transferred its contract to another consumer, the Empire Cotton Oil Co., the purchaser of its plant. The action of the purchaser, and its refusal to take any rock, operated at least to diminish the quantity specified in the contract to the amount of 10 per cent beginning one year after such date. The purchaser of the plant and transfer of the contract notified the seller, Phosphate Mining Co., in writing to decrease the quantity specified in the contract 10 per cent beginning one year from date of that notice, or one year from July 9, 1912.

The points having been determined in favor of the mining company, judgment for it was affirmed.

### Polishing Motor for Metal Sections

BY CHARLES Y. CLAYTON

While the microscopic study of metals is as a rule most interesting, the preparation of the specimen for study is generally an irksome task. Unless the polishing machines are carefully designed and arranged the task is usually a long one.

The common method now in vogue is to rough-polish

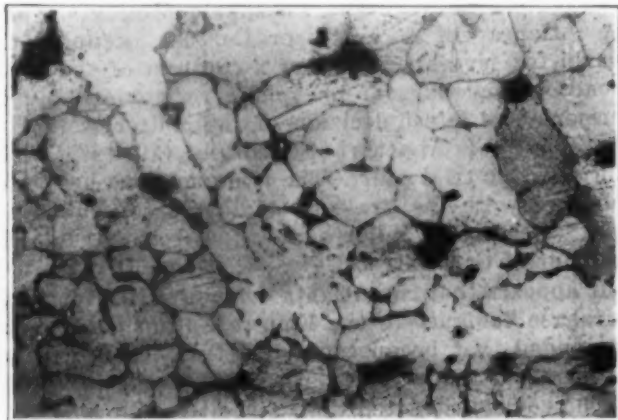


FIG. 1. CAST COPPER; ETCHED WITH  $\text{NH}_4\text{OH} + \text{H}_2\text{O}_2$   $\times 100$

on a vertical wheel and to finish on horizontal disks covered with the proper media.

Having experienced considerable trouble with horizontal disks mounted on spindles driven by belts or friction clutches, the writer designed a vertical motor with a rotor shaft sufficiently long for a threaded end to permit affixing a bronze disk.

The motor was made by the Cincinnati Electrical Tool

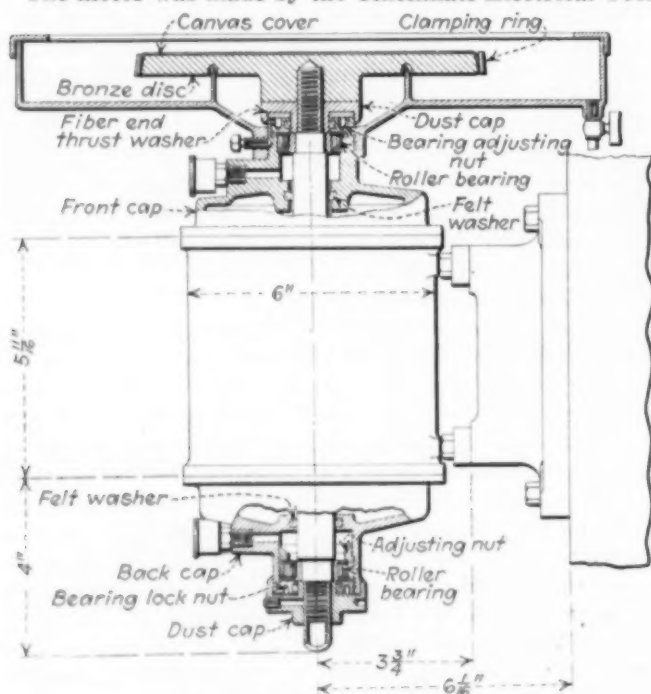


FIG. 2. DESIGN OF MOTOR

Co. It operates at 3,000 r.p.m. and gives complete satisfaction. Even soft metals can be polished with the proper care, as is shown by Fig. 1, a microphotograph of cast copper polished on this machine.

Fig. 2 shows the design of the motor, horizontal disk and water pan. Fig. 3 is a photograph of the assembled unit.

Rolla, Mo.

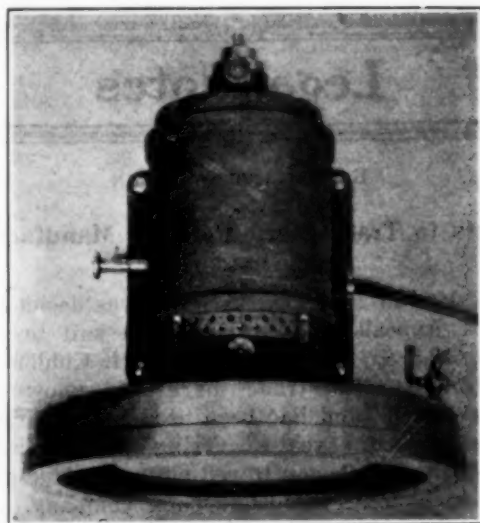


FIG. 3. ASSEMBLED POLISHING UNIT

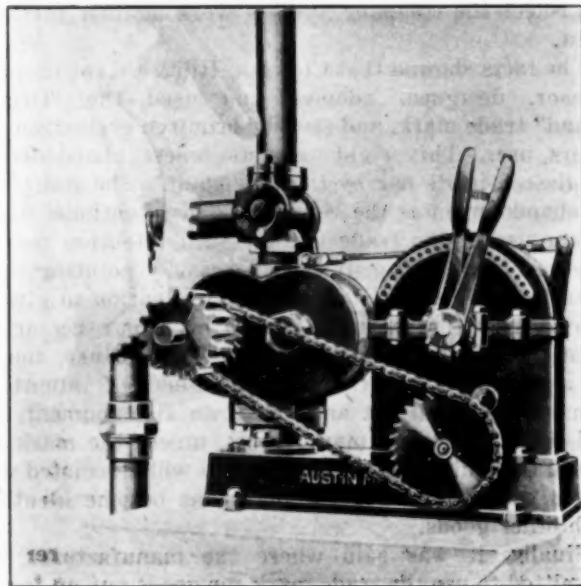
### Automatic Motor Pump

This is a novel device developed by the Austin Machinery Corporation of Chicago, for pumping and measuring the water discharged into concrete mixers. The importance of proper quantities of water in each batch of concrete mixed is well known, and this device will be welcomed as solving this much discussed problem.

The apparatus consists of a pump, a valve, a timer and pipe with fittings. The pump is driven from the mixer shaft and works continuously. It has a lift of 12 ft. from dead water level to pump or can take water from a hydrant. The two-way valve is opened and closed by means of a cam on the timer, which is in turn controlled by the starting lever. With the valve open, water is discharged to the mixer. When it is closed, water circulates through the return loop in the piping.

The operator opens the valve by throwing the starting lever over to the timing pin. Then he forgets it until the next batch is ready for water. The valve closes itself automatically at the precise moment the predetermined quantity of water has been discharged. The amount required is a matter of indifference, since the device has a range of about 250 per cent from minimum to maximum discharge.

The total equipment weighs less than 200 lb.



AUTOMATIC MOTOR PUMP

## Wallace Elected Secretary American Engineering Council

WHEN American Engineering Council of the Federated American Engineering Societies was organized in Washington last November the selection of an executive secretary was deferred until the field could be thoroughly canvassed to discover the man best suited for this important post. Practically three months later, at a meeting of the Executive Board of the Council at Syracuse, N. Y., Feb. 14, the board elected Lawrence Wilkerson Wallace to succeed L. P. Alford, who has been acting secretary since the formation of the Council.

Lawrence Wilkerson Wallace has been one of the most active figures in the Council and from the time it was organized has been its treasurer. As vice-chairman of the Council Mr. Wallace has been directing the work of the committee on elimination of waste in industry, one of the principal committees of the Council, whose scope, following the Syracuse meeting, will be greatly broadened.

Mr. Wallace was born in Austin, Tex., Aug. 5, 1881. He was graduated from the Agricultural and Mechanical College of Texas in 1903 with the degree of B.S. in mechanical engineering. In 1912 he received the degree of M.E. from Purdue University. From 1903 to 1906 he served a special apprenticeship with the Santa Fe Railway Co. at Cleburne, Tex., and was a member of the Purdue faculty during 1906-07, becoming head of the department of railway and industrial management in 1913.

As head of this department he was in charge of instruction pertaining to railway mechanical engineering and industrial engineering and of the research work carried on in the railway laboratories; made extensive research pertaining to locomotive performance through both laboratory and road tests and made an exhaustive study by road and laboratory tests on the possibility of fire from locomotive sparks, which information has been largely used in fire cases. His investigations have also covered tests of brake beams, truck side frames, truck bolsters and many other features of car and locomotive construction.

After leaving the university Mr. Wallace became assistant general manager of the Diamond Chain & Mfg. Co., Indianapolis, Ind. As assistant general manager he was in charge of the production during the war.

Upon leaving the Diamond Chain & Mfg. Co. he went to Baltimore, Md., and became director of the Red Cross Institute for the Blind, which was commissioned with the responsibility of giving vocational training to the blinded of the military forces. He left the Red

Cross Institute for the Blind on Jan. 1, 1921, to take charge of the investigation being conducted by the committee on elimination of waste in industry, appointed by Herbert Hoover.

He is author of a treatise on steel freight car design which is used by several universities as a text book; also prepared a number of instruction booklets for educational departments of railway companies; contributed various papers to railway and industrial engineering societies, papers covering varied topics pertaining to the activities of these two general groups.

Mr. Wallace is a member of the American Society of Mechanical Engineers and vice-chairman of the society's management section. He is now serving his third term as president of the Society of Industrial Engineers and is a past president of the Indiana Engineering Society. Mr. Wallace is a member of the International Railway

Fuel Association, Western Railway Club, Master Car Builders Association, Academy of Political and Social Science, and Western Efficiency Society. Mr. Wallace is prominent in Masonry, and is a past grand lecturer of the Grand Lodge of Indiana.

Mr. Wallace's social and commercial activities embrace a wide range. His work in New York as vice-chairman of the committee on elimination of waste in industry has been instrumental in bringing national attention to the purposes of the Council.

In an address before Engineering Council in Washington he summed up his idea of the function of the engineer as follows:

"It is the function and province of the engineer to make the correct analysis, to predict effect through known causes. It is purely the mission of the engineer of wide experience, of great foresight and of unselfish motive to see to it:

"First—That every action is based upon the principles of honesty, justice and fairness to the employee, the employer and the public.

"Second—To so formulate the plan of action as to eliminate all unfair privilege of employer and employee and to make it possible for each to fulfill its responsibilities to the community.

"Third—To so organize the plant or industry as to make it exceedingly difficult for an incompetent to hold a position of authority or to have autocratic control."

Mr. Wallace, now at the temporary headquarters of the Council in the Engineering Societies Building, New York City, will soon transfer his activities to Washington, where the Council has established permanent national headquarters in the McLachlen Building. The Employment Service Bureau will be continued in New York, with Walter V. Brown in charge.



LAWRENCE WILKERSON WALLACE  
Executive Secretary, American Engineering Council

## Current Events

### in the Chemical and Metallurgical Industries

#### American Engineering Council Begins War on Waste in Industry

American Engineering Council of the Federated American Engineering Societies held a two-day session in Syracuse, N. Y., Feb. 14 and 15. At this meeting President Herbert Hoover announced the appointment of a committee on elimination of waste in industry as follows:

J. Parke Channing, Dr. Ira N. Hollis, L. W. Wallace, H. K. V. Scheel, L. P. Alford, George D. Babcock, F. G. Coburn, Morris L. Cooke, Harrington Emerson, E. E. Hunt, C. E. Knoepfel, Robert Linton, Fred J. Miller, J. H. Williams and Robert B. Wolf.

It was announced that the committee has already begun work and will study the nation as a single industrial organism to locate the weaknesses in the country's industrial system. An announcement by the Council says:

"The Federated American Engineering Societies, in which the national and local engineering societies of the nation are coalescing, is organized for public service. Unemployment, intermittent employment, strikes, lockouts and restrictions of output are waste. Disuse and misuse of machinery and equipments and losses of manufacturing materials are likewise waste. Stabilization of industry is a crying need, and also an engineering problem. Labor, capital, management and the consuming public stand to gain if common constructive action can be taken to lessen the idleness of men, idleness of productive equipment and the utilization of material."

The Council gave formal approval to the action of the committee on procedure requesting that President Harding put an engineer on the Interstate Commerce Commission. The procedure committee was authorized to name six qualified engineers when requested to do so. Activity in behalf of a National Department of Public Works will be continued by the Council through the public affairs committee. It was recommended that engineering efforts be extended to the whole question of Government reorganization planned under a special congressional committee.

The plan for the registration of engineers as presented in the Council's report was indorsed and the appointment of another committee was authorized.

An invitation from Philadelphia engineers to hold the April meeting in that city was accepted. The June meeting will be held in St. Louis.

The Council decided to recommend to President Harding that an engineer be appointed Assistant Secretary of War. No action was taken relative to the National Civic Federation, Fuel Conservation or Merchant Marine committee appointments.

#### Alloy Steel Patent Case Before Supreme Court

A case which may have a far-reaching affect on all chemical patents is now before the Supreme Court of the United States. The Churchward International Steel Co. has petitioned for a writ of certiorari in its case against the Bethlehem Steel Co. The Churchward company is the owner of certain patents covering alloy steel. It is alleged that the Bethlehem Steel Co. has infringed on these patents. The issue in the case, however, is the validity of the patents. The trial court found them to be valid and infringed. The Circuit Court of Appeals for the Third Circuit, however, reversed the lower court on the validity of the patents. The Circuit Court of Appeals' finding was based on an assumed inutility of the patent alloys and on an assumed lack of novelty in the alloy composition.

The Churchward company makes the point that if the patent alloys are of no special merit the Bethlehem company would be in the position of defrauding the Federal Government for selling such steel at a price of \$800 per ton. More-

over, it is pointed out that if the steel made by this formula had no special merit the safety of naval officers and sailors was menaced by the use of this steel in naval craft. The Churchward company also claims in its petition to the Supreme Court that if the decision of the Circuit Court of Appeals should be allowed to stand it would "result in the imposition of the burden of proof on inventors in the chemical arts, not imposed on any inventor in the mechanical arts, and a burden which has no statutory foundation, for Judge Woolley holds that to be patentable a chemical composition must be not only new, original and useful but must possess marked superiority. Such a doctrine is in conflict with the established precedence in the mechanical arts, where the similar test of patentability is one of utility and not of comparative utility."

The Churchward company states in its petition to the court that the Carnegie Steel Co. had infringed on these patents but that the matter had been settled out of court by payment of \$275,000.

#### Plan Symposium on Drying for Rochester Meeting, A.C.S.

The Division of Industrial and Engineering Chemistry will hold a symposium on drying at the Rochester meeting of the American Chemical Society during the week of April 25, giving particular attention to the six points of interest to the chemical engineer. These points have been selected as follows:

1. Transmission and distribution of heat in drying.
2. Temperature control of material in drying.
3. Effect of atmospheric conditions in drying.
4. Economy in drying.
5. Cost of drying.
6. Solvent recovery.

Thus far papers have been obtained from authorities on rotary driers, solvent recovery, compartment driers, vacuum drying and spray drying.

The chairman of the committee organizing this symposium is Charles O. Lavett, of the Buffalo Foundry & Machine Co., Buffalo, N. Y.

#### Industrial Survey Being Made at Old Hickory

As a part of its plan for industrial development at Old Hickory the Nashville Industrial Corporation is having a survey made of the whole powder plant. This investigation, which is being conducted by Meigs, Bassett & Slaughter, Inc., chemical engineers, of Philadelphia, will cover in detail possible uses for and means for disposing of the various units of the plant, which include:

Fifteen contact sulphuric acid plants, 7 nitric acid plants, 7 cotton purification plants, 7 cotton dry houses, 9 nitrating houses, 5 mix and weigh houses, 9 boiling tub houses, 9 pulping houses, 9 poacher houses, 16 solvent recovery houses, 1 diphenylamine plant, 1 causticizing plant, 4 box factories, 3 chemical laboratories, 3,500-ton refrigerating plant.

The diphenylamine plant is especially adaptable for a dye-making company, and is a separate and distinct unit in itself, having a 1,500-hp. steam plant, its own refrigerating system, independent warehouses, a hospital and a restaurant. It is located sufficiently distant from the village to protect the inhabitants from any fumes therefrom.

Some of the factors which are favorable to the establishment of manufacturing plants at Old Hickory may be summarized as follows: A power plant capable of supplying more steam and electricity than a community of 30,000 could use; a water reservoir and filtration plant which could meet the needs of a city the size of Boston; 1,138 six-room houses for which only a small rental is asked; excellent sanitary arrangements.

### Duty on Potash Asked

A duty of 50c. a unit on imports of potash has been asked by the United States Potash Producers Association. Wilbur LaRoe, Jr., appeared for the domestic producers. He laid particular stress on a statement that the potash industry has a highly diversified ownership and that it is in no way controlled or influenced by the packing industry. Mr. LaRoe points out that the duty asked is only 20 per cent of the present price of potash. He stated that the industry was born under war conditions when potash was worth \$5 a unit. He said that the freight rate from the West to the East is 60c. a unit. In connection with his testimony, Mr. LaRoe submitted a number of tables, among which are the following:

POTASH PRODUCTION AND CAPITALIZATION, 1920

	Number of Producers	Production, Salts, Tons	Production, $K_2O$ , Tons	Per Cent of Total	Capital Invested
Natural Brines:					
Nebraska lakes..	8	84,168	21,439	44.0	\$7,846,000
Other brines....	5	52,151	16,688	34.3	12,889,782
Alunite, silicates and kelp.....	5	4,562	2,282	4.7	4,070,000
Molasses distillery waste....	4	9,882	3,433	7.1	717,861
Sugar mills.....	3	8,609	3,325	6.8	921,000
Blast-furnace dust.....	5	2,102	155	0.4	3,000
Cement-mill dust	5	12,071	1,035	2.1	2,021,000
Wood ashes.....	19	453	299	0.6	227,500
Total.....	53	173,998	48,656	100.0	\$28,696,143

POTASH PRODUCTION BY STATES

State	Number of Plants	Available Potash Quantity, Short Tons	Content of Potash ( $K_2O$ ) Percentage of Total
Nebraska.....	8	21,439	44.0
California.....	11	12,013	24.7
Utah.....	3	10,282	21.1
Pennsylvania.....	5	183	.4
New York, New Jersey and Maryland.....	4	1,739	3.6
Virginia, Ohio, Colorado, and Porto Rico.....	4	2,735	5.6
Wisconsin.....	10	231	.5
Michigan.....	8	64	.1
Total.....	53	48,684	100.0

### The American Fertilizer Industry

The present status and tendencies in the fertilizer industry were discussed from many points of view at a symposium of the Chemical Society of Washington on Feb. 10. At this meeting fertilizer use, phosphates, potash, nitrogen resources, fertilizer utilization and the future prospects of concentrated chemical fertilizers were all discussed by specialists in these fields.

#### TENDENCIES IN FERTILIZER INDUSTRY

William D. Hurd, director of the soil improvement committee of the National Fertilizer Association, summarized the present tendency of the industry. The relation of fertilizer use to the quality and quantity of crops produced was especially emphasized, and it was pointed out that this, the largest heavy chemical industry, is operating through 700 plants which produced in 1920 over 7,000,000 tons of product valued at over a quarter of a billion dollars. Some of the tendencies of the industry are particularly important. Those emphasized by Mr. Hurd were: A change from scavenger to chemical industry; the production of fewer brands; the use of higher percentages of plant foods in the fertilizers; the sale on the basis of pounds of plant food required per acre instead of pounds of fertilizer per acre; the use of domestic sources of raw materials previously imported; the adaptation of fertilizers to plant needs with particular attention to plant physiology; a clearer recognition of proper selling methods and an improved standard of ethics throughout the industry; the tendency to throw aside old long-held fallacies and emphasize the scientific business of farming.

#### PHOSPHATES AND PHOSPHORIC ACID

W. H. Waggaman of the Bureau of Soils discussed the present phosphate situation and certain suggestions for phosphoric acid production in relation to fertilizer development. He pointed out that America is independent of foreign sources of phosphate, a condition quite in contrast

to that found during the war period with respect to nitrogen and potash, the two other important fertilizer constituents. It is estimated by the Bureau of Soils that there is a reserve of phosphate materials of at least ten billion tons. These reserves are being drawn upon extensively in Florida, Tennessee and South Carolina and to a very much lesser degree elsewhere. These three states furnished approximately 2,500,000 tons, 500,000 tons and 50,000 tons respectively in 1920. The most serious aspect of the phosphate development is the large waste due to washing and screening of the product during preparation. It is estimated that only 15 per cent of the rock mined is saved and that more than twice as much phosphate goes on to the dump as to the market.

It was the effort to save these wastes of phosphate that led the Bureau of Soils several years ago to develop a pyrogenic method for phosphoric acid production which has been described (see CHEMICAL & METALLURGICAL ENGINEERING, p. 1057, Dec. 1, 1920). It is believed that the process described can be operated electrically to give phosphoric acid as cheaply as from the sulphuric acid method when power is available at \$25 per hp.-yr. When oil-firing is used the cost for fuel is only one-third. Hence under most circumstances it is believed that this will be a most economical system. The application of the phosphoric acid to phosphate rock produces the most concentrated phosphate fertilizer, perhaps best characterized as "treble" phosphate because it contains about three times the available  $P_2O_5$  that is usual.

#### EFFECT OF BORAX

In a number of cases the problem of borax has been considered very serious. In fact during a single year the losses due to borax in the salt resulted in tremendous losses especially to Maine potato crops. A full discussion of this point at the meeting showed that it is no longer a problem to be feared, as salts well under one-half of 1 per cent borax are now supplied and in every case a guarantee not to exceed 1 per cent can be observed.

#### NITROGENOUS MATERIALS

Nitrogen resources and the possibilities and requirements of the country were discussed by Captain D. P. Gaillard of the Nitrate Division of the Ordnance Department. He pointed out the import situation, the relative importance of domestic nitrogen sources and the present status of nitrogen demand with prophecies for ten years to come. These phases of the subject have already been fully discussed in CHEMICAL & METALLURGICAL ENGINEERING, vol. 22, pp. 783 and 841.

#### CO-ORDINATION OF SOIL, PLANT AND FERTILIZER

Dr. Oswald Schreiner of the Bureau of Plant Industry pointed out in his discussion that fertilizer as applied to the soil is really a raw material of food production and agricultural manufacture. Viewed from this standpoint, it is necessary in fertilizer utilization to plan upon proper co-ordination of soil, plant and fertilizer. The work of the Bureau of Plant Industry on this subject was described by Dr. Schreiner particularly with reference to the proper selection of fertilizer types for different soil types.

#### POTASH SITUATION

The potash situation of today was discussed by F. W. Brown, secretary of the U. S. Potash Producers Association. Mr. Brown contrasted the present situation under which many potash producers of America have been compelled to suspend operations with the conditions which prevailed during the war period. He estimated that the production in 1920 amounted to 175,000 tons of potash salts, or 40,000 tons of  $K_2O$ . Of this the Nebraska lakes supplied 44 per cent, other brines 34 per cent. At the present time most of the small Nebraska plants are closed, but eight of the large companies are still operating. Whether they will continue successfully depends upon the measure of protection granted as a result of the present tariff legislation.

The 1920 potash operations demonstrated, according to Mr. Brown, one very important fact—namely, that these plants could operate on brines containing not over 3½ per cent of solids. The 1920 season was excessively rainy and

operation on these low percentage brines was therefore necessary, whereas previously a 7 per cent brine was considered the minimum which could be commercially worked. In Mr. Brown's opinion, this experience has demonstrated the almost indefinite extension possible in the potash brine development. The separation processes now are giving 45 per cent salt instead of 25 per cent salt formerly supplied and caustic and soda ash are becoming important sources of byproduct income.

#### CONCENTRATED FERTILIZERS

R. O. E. Davis of the Bureau of Soils discussed the subject "Concentrated Chemical Fertilizers, A Future Prospect." This discussion brought out the possibilities of using as fertilizers potassium and ammonium phosphates and potassium or ammonium nitrates. Two methods of application are available: First, by solution in water and sprinkling upon the land, and second, by mixing with soil on the farm to permit application by drilling into the soil as is now customary with mixer fertilizers.

The discussion of this subject brought out the possibility which is recognized by some that the use of chemical fertilizers may not answer the entire need of the plant any more than use of concentrated food without vitamins will answer the human need for food. However, it was pointed out that the soil as an active bacterial culture, which in effect it is, probably can care for these other needs without the artificial addition of these materials. The discussion also brought out the interrelation of many of the fertilizer problems with other industrial chemical problems of great importance, all of which emphasizes the importance to the chemical industry of this field of industrial activity.

#### Barrels and Cans for Petroleum Products

The manufacture of barrels and tin cans was explained and illustrated Monday evening, Feb. 7, before the Rochester Section of the American Chemical Society by Florus R. Baxter, chief chemist of the Vacuum Oil Co. Mr. Baxter told how years ago all barrels were made by hand and a man who could make ten or twelve barrels a day was a rapid worker. Now machinery has been invented and improved so that the greater part of the barrels are made by machinery. The present capacity of the Vacuum Oil Co.'s Rochester plant is about one million barrels a year.

To make these million barrels requires an enormous amount of materials—for instance, about eighteen million staves, one million pair of heads, and quantities of iron hoops, glue and paint. About four thousand acres of timber land is required for each year's supply. These timber lands are in Arkansas, Kansas, Kentucky, Tennessee, Alabama, Mississippi, Louisiana and Georgia.

First the lumber camp is established. The trees usually cut are those 50 ft. high and 2 ft. in diameter. No trees less than 14 in. in diameter 7 in. from the ground are cut. It takes about thirty years for the young trees to develop the required size. After the tree has been cut it is sawed into required length for staves or heads. The lengths for the staves are sawed on a cylinder so they are curved a little, and the staves are piled up in the air to dry. After the air-drying they are piled on edge and kiln-dried. The heads are cut out and piled in chimney form to air-dry for from three to six months. The staves and heads are shipped from the lumber camps to the factory.

The actual making of the barrel now begins. The staves are fitted inside a head hoop, and steamed to soften the staves so they may be bent. After bending the truss hoop is then put on and the moisture dried out. The bung hole is next put in. The iron hoops are next riveted together and flared on a machine and put on the barrel in place of the truss hoops. The ends of the staves are beveled and the groove cut to accommodate the heads.

The barrels are then inspected and all worm holes filled. The inside is covered with glue by putting glue inside the barrel and rolling it down an irregular incline so the glue is evenly distributed. Next the barrel is aged for ten or fifteen days, after which the hoops are again driven on. Another heavier coating of glue is put on the inside and allowed to dry. The barrel is then painted and dried, and

painted again and cured in a forced air drier. After inspection it is weighed and the weight stenciled on.

Now the barrels go to the filling room, where they are filled, automatic fillers being used. The bung holes are filled with a wooden plug and the oil is ready for shipment after being weighed and the gallons of oil computed. In the cars the filled barrels must be carefully wedged to keep them from rolling about.

#### TIN CANS

Mr. Baxter then took up the manufacture of the 1-gal. and 5-gal. tin cans. Most of the tin comes from Cornwall, England, although lesser amounts are found in other parts of the world. The tin is extracted from the ore by roasting. After several washings and smeltings the pure tin is recovered. Sheets of tin plate are formed, using a coating of palm oil, which is later removed by bran or sawdust. Then the sheets are decorated to suit the manufacturer. In this case they are enameled white and the trade mark is stenciled on.

The cans are made on machines which turn a hem on the sheet of tin and later close the seam. The tops and bottoms are put on and the seams soldered. The spout is then put on and after testing the cans go to the filling room. The cases in which the cans are packed are also made at the factory.

Throughout the factory and in the loading of cars, wherever possible, the barrels and cans are transported on conveyors.

#### Average Wages in New York Chemical Plants for November, 1920

A report issued recently by the New York State Industrial Commission gives the average weekly earnings in representative manufacturing industries in New York State for November, 1920. Figures for the corresponding month in 1914, 1916, 1918 and 1919 and the per cent increase of

#### AVERAGE WEEKLY EARNINGS IN NEW YORK STATE FACTORIES

Industry	Average Weekly Earnings in November					Per Cent Increase, 1920 Over 1914
	1914	1916	1918	1919	1920	
Stone, clay and glass products.	\$13.30	16.22	\$23.32	\$26.41	\$32.06	141.1
Miscellaneous stone and mineral products.....	14.60	18.85	23.67	27.82	34.43	135.8
Lime, cement and plaster...	13.18	16.58	25.47	29.55	34.37	160.8
Brick, tile and pottery.....	11.61	13.73	18.81	24.00	28.70	147.2
Glass.....	14.30	15.83	24.41	24.90	31.16	117.9
Metals:						
Gold, silver and precious stones.....	13.09	17.50	24.17	30.68	34.97	167.2
Brass, copper, aluminum, etc.	12.67	16.57	23.09	26.34	29.14	130.0
Pig iron and rolling mill products.....	16.79	21.85	35.34	35.10	40.78	142.9
Leather.....	11.12	15.28	20.40	24.52	26.68	139.9
Rubber and gutta-percha goods	11.41	13.31	17.27	23.57	26.49	132.2
Paper.....	13.28	15.96	23.91	26.71	32.36	143.7
Chemicals, oils, paints, etc.	12.80	15.37	20.96	25.20	28.71	124.3
Drugs and chemicals.....	12.36	15.01	17.90	25.05	27.71	124.2
Paints, dyes and colors.....	14.33	15.38	20.77	23.39	27.13	89.3
Animal and mineral oil products.....	12.93	15.67	23.49	25.76	28.98	124.1
Miscellaneous chemical products.....	12.30	15.94	19.81	24.91	29.61	140.7

1920 over 1914 are given for comparison. Employees in both office and shop are included, the effect of higher office salaries on the average being offset by the small number of office employees. Figures of interest to the chemical and metallurgical fields are given in the accompanying table.

#### New Tariff for Camphor Proposed

An attempt is being made to embody in the emergency tariff bill a duty of 50 per cent ad valorem on camphor. This step is taken in the interest of the synthetic camphor industry in the United States. The emergency tariff is being confined to agricultural products, but it is being argued that the income from turpentine recoveries forms an essential part of the revenue of farmers in the naval stores belt.

Among the articles added to the emergency tariff bill by the Senate is sugar. An additional duty of 1c. per lb. is provided.

### Chicago Chemists' Club Smoker

The members of the Chicago Chemists' Club held an informal smoker at the quarters, 315 Plymouth Court, on Wednesday, Feb. 9. The address of the evening was delivered by Dr. Rollin B. Salisbury, dean of the Ogden Graduate School of Science, University of Chicago, who spoke on the origin of the earth. It seems that the earth is not a hot ball thrown off from the sun as is popularly supposed, but was developed by the accumulation of great numbers of smaller bodies revolving about the sun. The earth is still accumulating such material at the rate of about 50,000,000 meteorites per day. It is estimated that human life existed on the earth at least 1,500,000,000 years ago. He spoke of the work of English scientists in determining the age of rocks by use of radio-active substances. Without reference to religion the principal point of informal discussion centered around the origin of the original mass of matter or nucleus from which the solar system was developed.

### The Drying of Paper

The regular February meeting of the Connecticut Valley Section of the Technical Association of the Pulp and Paper Industry was held in Holyoke Tuesday evening, Feb. 15, with an attendance of seventy-five members.

Mr. Farnsworth of the Farnsworth Engineering Co. of Conshohocken, Pa. spoke on "The Drying of Paper," with especial reference to the system developed by his company. He said that drying conditions had been the subject of investigation for years, for proper drying constitutes one of the fundamentals of paper manufacture. The introduction of any system to the industry as a whole is virtually impossible. In fact, he said that strictly speaking his own company had no real system, for each paper machine represented a different problem. The many grades of paper made and the many different types of machines in use rendered anything standard out of the question. It is possible to start out with one general outline of procedure and vary the details according to conditions.

The system which he has worked out depends for its efficiency on being entirely closed. By means of special valves it is possible to keep the condensate under pressure and return it to the boilers at a high temperature, thereby saving a large amount of heat. In such cases the volume of make-up water added to the system to replace losses is very small. The essential feature in the system consists in passing steam through a reducing valve set at any desired pressure and then to a number of drying rolls on the dry end. These driers are in parallel and the amount of steam entering each one is controlled by a throttle valve.

The exhaust steam from this set of driers is collected in a header, the condensed water trapped off and the balance of the steam passes directly into a set of driers at the wet end. The amount of condensate here is much greater than at the dry end and the number of driers in the set is adjusted so as to make the condensation cause sufficient reduction in pressure to pull the steam rapidly through the first series of driers and thereby prevent the accumulation of condensed water in the drying cylinders and at the same time to remove air from them.

Steam coming out of the driers at the wet end flows into a special apparatus where the make-up water is added as a spray, thereby condensing part of the steam and creating enough reduction in pressure to insure a rapid flow of steam through all the driers at the wet end.

All this condensed water is above the boiling point; its exact temperature depends on the conditions of operation of the paper machine and the pressure maintained. It is collected in special tanks and blown back to the boiler feed tank by high pressure steam let in at the top of the collecting tanks by an automatic valve arrangement which operates only when the tank is full.

For most paper machines the driers may be divided into two sets in series parallel arrangement, although more divisions may be necessary for certain types, especially of board machines.

The problem of proper drying, he said, consists in getting a gradual rise in temperature all the way along the driers

with the wet end at the lowest temperature. This must be done in such a way as to get the greatest economy in steam possible in order to meet modern industrial conditions.

### Meeting of the New York Chapter of the American Society for Steel Treating

The New York Chapter of the American Society for Steel Treating held its meeting on Feb. 15, at the Machinery Club, New York City. Colonel A. E. White, the national president of the society, was the speaker of the evening. He outlined the present status of the society and said that during the short period of its existence the membership has grown to 2,959 and that since September, 1920, three new chapters have been instituted (Syracuse, N. Y., Charleston, W. Va., and Gary, Ind.) and that the next annual meeting would in all probability be held at Indianapolis, Ind. He then presented his paper on "Alloy Steel, Its Rise and Secrets."

Colonel White reviewed the great importance of iron in our present-day life and the history of the rapid growth of the steel industry in the United States. Electric steel, which was first manufactured here in 1908, reached a production of about 511,000 tons in 1918 and about 2,000,000 tons in 1920 and is steadily gaining in favor. The growing demands of the automobile industry and of armaments have influenced the development of the alloy steel industry. He then spoke on the theories proposed by Osmond and Edwards on the relations which exist between the elements and their influence in alloy steels. Osmond classified the main elements entering into alloy steels according to their

atomic volume ( $\frac{\text{atomic weight}}{\text{specific gravity}}$ ) and grouped them into two

classes according to whether the atomic volume is below or above 7.2 thus:

Class I		Class II	
Element	Atomic Volume	Element	Atomic Volume
C	3.6	Cr	7.7
B	4.1	W	9.6
Ni	6.7	Si	11.2
Mn	6.9	As	13.2
Cu	7.1	P	13.5
		S	13.7

Edwards uses the classification as given in Mendeleef's periodic table of elements. Colonel White also spoke of the laws of Léon Guillet on the influence of the variations of the carbon content, or of the special elements, or of both, on the constitution of the alloys. A series of equilibrium diagrams were shown to illustrate the theory of the coefficients of equivalence as applied to alloy steels. (Guillet's theory of the coefficient of equivalence as applied to ternary alloys was published in *CHEMICAL & METALLURGICAL ENGINEERING* of Jan. 26 and Feb. 9, 1921, pp. 177 and 261.)

In the discussion that followed it was brought out that zirconium steel does not present any special useful property at present known.

### Alleged Gas Injuries Being Investigated

Manufacturing chemists are being asked by the Chemical Warfare Service for data in regard to the effects of gases on workers. It is believed that valuable information can be secured from chemical plants that have been manufacturing gases over a period of years.

More than 900,000 claims have been filed with the Government for compensation based on injuries received while in the military service. Of this number about 25 per cent are for alleged injuries due to gas. Studies that have been made by officials of the Chemical Warfare Service indicate that injuries from gas usually are as well defined as are wounds from projectiles. They do not take much stock in the claims that there are delayed effects arising from poison gas. They have not been able to trace a single case of tuberculosis which they are satisfied had its origin in gas. In the matter of compensation claims, however, the Government apparently must bear the burden of proof. In that connection General Fries expects to go minutely into the

records of industrial employees who have been handling gases.

The Chemical Warfare Service has undertaken to investigate some of the alleged after-effects of being gassed. In several of the cases it has been shown conclusively that the claimant was in error in his assumption that gas is responsible for his condition.

### Paris-Havre Oil Pipe Line Delayed

Owing to the drop in the price of coal in France and the general business depression, work on the proposed oil-pipe line between Havre and Paris has been indefinitely suspended after nearly 20,000,000 f. has been expended on preliminary work. However, plans will be completed by the Stewart Construction Co. of New York with the hope of construction being resumed in ninety days.

The project, which is being financed by the Atlantic & Gulf Refining Co. through a French holding company, was designed to supply cheap fuel to industries in Paris.

### Dye Industry Lags Pending Action on Dye Legislation

Hesitancy on the part of dye manufacturers to lay out a definite program of production for 1921 in the face of uncertain dye legislation is shown by their delay in placing contracts for sulphuric and nitric acids. This was brought out in an analysis of contract renewals made by several large acid manufacturers for the purpose of explaining an unexpected decrease in the amount of acid placed on contract.

## Personal

Dr. GEORGE BORROWMAN, who for thirteen years was professor of industrial and engineering chemistry at the University of Nebraska, subsequently to which he did some research work with Dr. J. E. Teeple of New York, has recently entered independent practice in Chicago.

A. H. JONES has taken over the metallurgical laboratory and engineering business of Charles Butters & Co., Salt Lake City, Utah, under the name of the A. H. Jones Co.

WILLIAM B. LEACH, JR., has been discharged as Captain, C.W.S., in charge of the Experimental Division, and is now assistant manager at the Mathieson Alkali Works, Inc., Niagara Falls, N. Y.

Dr. JOHN A. MATHEWS has been elected president of the Crucible Steel Co. of America. Dr. Mathews has been identified with the company since 1902, and was vice-president for about a year.

Major J. E. MILLS, professor of chemistry at the University of South Carolina, has been chosen as an official consultant of the Chemical Warfare Service. Major Mills went to France with the first Chemical Warfare troops and was among the last officers of that service to leave that country.

Dr. R. B. MOORE, chief chemist of the Bureau of Mines, has delivered a number of lectures recently on helium, one of which he gave at the University of Illinois Section of the American Chemical Society on Feb. 16.

A. V. H. MORY, of the Procter & Gamble Co., Cincinnati, was in Chicago recently.

J. G. NEWTON, formerly with the Cerro de Pasco Copper Corporation, La Fundicion, Peru, is associated with the American Smelting & Refining Co., Maurer, N. J.

Dr. CHARLES WADSWORTH, 3d, who received the degree of Ph.D. in 1916 from Harvard University and who has recently been in charge of research and developments at the plant of Zinsser & Co., at Hastings-on-Hudson, N. Y., is now chemical engineer with the Grasselli Chemical Co. at East Chicago.

## Book Reviews

TEXTBOOK OF CHEMISTRY FOR NURSES AND STUDENTS OF HOME ECONOMICS. By Annie Louise Macleod. New York: McGraw-Hill Book Co. 180 pages, illustrated. Price \$2.25.

In this textbook the author has presented the subject in a manner readily understood by a layman, giving in a practical way the chemical principles underlying nutrition, dietetics and cookery. Nurses of the present day customarily have at least a high school education, which gives them more than sufficient knowledge of chemistry to make the book readily understood and applied. The author has kept her work well within the scope indicated by the title, as a consequence of which it can be purchased by nurses and students of home economics with the assurance that it will meet their needs.

## Current Market Reports

### The Chemical and Allied Industrial Markets

NEW YORK, Feb. 18, 1921.

A marked improvement has taken place in the demand for general chemicals during the past week. All signs point to better business in the very near future and prices are showing more stability in many directions. Resumption of operation is going on steadily among textile mills and tanneries as well as in other branches of the consuming trades. A gradual expansion is also noted in the call for export shipments and inquiries have reached the chemical market from various foreign countries on a fairly large scale. Resale stocks have been steadily decreasing, while the output among large producers has been sharply curtailed. Under this condition manufacturers seem to be in better control of the situation than at any time previously and it looks as though the time is ripe for the pendulum to swing back on price movement. Any large inquiries that have reached the market for spot material have been filled with difficulty, and in some instances it has been surprising to see how little actual stock is held by second hands. Liquidation in the past few months has been quite thorough and almost every item is in a position to respond to any permanent expansion in the extent of demand.

Among the large chemical items that merited interest was *soda ash*. Inquiries for this basic chemical reached the market from some of the leading foreign countries. The domestic inquiry was also more active and sales of 100-ton lots passed at 2c. per lb. in single bags f.o.b. N. Y. Japan has come into the market again and an inquiry was noted for a large tonnage over the year for ash and caustic soda. Interest on the part of Japan leads prominent factors to believe that the Orient might be one of the first sections to recover from the present industrial slump. *Bichromate of soda* attracted attention at prices ranging from 8½@8¾c. lb. Spot material showed a firmer tendency during the week and there appeared to be relatively little stock offered among second-hand interests. Sales of late have been confined mostly to small lots and it is said to be doubtful if a round quantity could be purchased without advancing quotations. Resale lots of light *soda ash* were offered sparingly at prices ranging from \$2.10@2.20 per 100 lb. in single bags. Barrels were quoted firm at 2¼c. lb. with only an odd car available here and there. Producers' prices for contracts still remain unchanged at \$1.72½ per 100 lb., bases 48 per cent, f.o.b. works in single bags. Holders of resale *caustic soda* are asking \$3.90@4 per 100 lb. in most quarters. An odd car could probably be bought at \$3.85 or thereabout, but the general market shows a strong undertone with no apparent pressure of resale stock to record.

Trading continued along quiet lines and the condition was reflected in a slight irregularity of quotations. Small lot sales of solid caustic were reported as high as \$4.10 per 100 lb. Manufacturers' contract prices remained unchanged at \$3.60 per 100 lb., basis 60 per cent, f.o.b. works for prompt and future shipments.

Sellers of *aluminum sulphate*, iron free, are quoting the market at prices ranging from 3½@4c. per lb., depending upon the quantity of the inquiry. The movement of late has been along quiet lines. Moderate quantities of the commercial variety are offered at 2¼@2½c. per lb. Spot *formaldehyde* in the open market is offered at 17½c. per lb. and it is intimated that actual round lot business would shade this figure. The demand is fair, with competition rather keen to secure what business is passing. Dealers are quoting moderate quantities of *prussiate of soda* at 16¼@16½c. lb. on spot and in some directions 17c. is asked. Shipments from abroad that are due to arrive this month are offered at 15½c. lb. Domestic producers are holding contract prices firm at 18c. lb. Limited quantities of *yellow prussiate of potash* were offered at prices ranging from 29@32c. per lb. ex-store N. Y., depending on sellers. Supplies of this chemical are said to be low at the present time. Moderate quantities of imported *bleaching powder* were offered by dealers at 2½@2¾c. per lb. on spot. Some interests stated that only small quantities could be purchased at the inside figure and quoted the market as high as 3c. per lb. Small drums were quoted at 3¼@3½c. per lb. according to seller. A fair inquiry was in the market and the tendency was reported firm. Irregular quotations on *nitrite of soda* have been named throughout the entire week. Sellers have quoted as low as 6c. and as high as 9c. per lb. Demand has not shown very much activity and most of the business placed was said to be within the range of 6@6½c. per lb.

Trading in *alcohol* during the past week took on a little more activity both in domestic and foreign quarters. Prices are quoted by leading factors at unchanged levels, but in view of the strong competition it is quite possible to do business at lower figures. *Ethyl alcohol* ranges from \$5.25@ \$5.50 per gal. for domestic consumption, while for export 55@58c. per gal. is heard. *Denatured* ranges from 54@60c. per gal. Pure *methanol* is offered at \$1.50 per gal., although the regular market is quoted at \$1.60.

#### COAL-TAR PRODUCTS

The tone of the coal-tar products market has improved somewhat during the past week and reports from various quarters of the allied markets are very encouraging from the standpoint of a wider spread of operations and the handling of orders on a larger volume. There is still little talk along contract lines. In the crude products the tendency is steady and some of the items are moving freer. *Benzene* is firmly held in first hands at 30@36c. per gal. *Naphthalene flakes*, prime quality, holds at 9c. per lb. and in second hands at 8@8½c. Dealers' offerings of intermediates have been available in various quarters and sellers have shown little intention of naming any lower levels among their offerings. First hands are quite steady in their views with their prices listed somewhat higher, although firm orders on round lots might bring about shading.

*Aniline oil* seemed to be easy in some quarters while *para-nitraniline* is reported firm, with one manufacturer quoting \$1.05 per lb. on contract basis. Producers of *beta naphthol* are firm in their views on prices and quote on a basis of 42@45c. per lb. Offerings of cheap resale lots have been diminishing of late and the best quotation obtainable was 32c. per lb. The consuming element of *dimethylaniline* is still holding to a hand-to-mouth buying. Producers are firm in their views at 60@65c. per lb., while resale material ranges from 50@55c. Factors report the market for *meta-phenylenediamine* rather dull, with material available in fair volume and moving slowly in a routine manner on a basis of \$1.25@\$1.30 per lb. A fairly steady demand of a routine nature continues for *monochlorobenzene*. Producers report a regular output and quote prices steady at 14@16c.

per lb. Manufacturers of *para-phenylenediamine* seem to be in fair supply while the outside market has little to offer. Trading is picking up and prices are holding steady at \$1.90@\$2.20 per lb. A steady improvement in the fur industry will help bring about more stabilized prices for this commodity.

#### VEGETABLE OILS

The spot market for *chinawood oil* was irregular, with prices ranging from 9¼@10c. per lb. On the Pacific Coast prices were quotably unchanged at 8c. per lb. sellers' tanks and 8¼c. in cooerage. Trading in *coconut oil* was quiet, but prices showed very little change locally. *Ceylon oil* was held around 8½c. lb. sellers' tanks f.o.b. New York. There was a good call for spot *olive oil* and with supplies cleaned up the market at the close was more or less nominal. The uplift in exchange caused some operators to advance their prices for *palm oil* for shipment. *Lagos* closed at 7½@7¾c. per lb. c.i.f. New York. The market for crude *soya bean oil* was a dull affair among local dealers. Importers quote the market for shipment goods at 4¼@5c. per lb. sellers' tanks. For jobbing lots in barrels 7½@8c. per lb. seem to be the general quotations.

#### The Iron and Steel Market

PITTSBURGH, Feb. 18, 1921.

Last week's report noted that the steel market had suddenly begun to break. A week's experience with the "break" shows that it is a very tame affair indeed, altogether lacking in vitality. It is simply a case of the buying demand being so extremely light that it could not nurture a real break. This break is therefore altogether different from the various breaks in the steel market that have occurred in the past. The normal course in a break is for some mills to name cut prices and get some orders, whereupon other mills cut lower and get orders for themselves, other mills, or the first mills, then making fresh cuts, and so on. There must be some buying on the way down.

At the present writing many of the independent mills are naming cut prices from the Industrial Board or Steel Corporation prices, but a larger number are not, because they have not the opportunity. They are prepared to sell at reduced prices, but are awaiting bids by customers, or the expression of a willingness to buy.

Lowest prices actually done or quoted to date, as compared with the Steel Corporation prices, which represented the whole market after the independents reduced their prices to the corporation level late in 1920, are as follows: Bars, 2c., against 2.35c.; shapes, 2.25c., against 2.45c.; plates, 2.25c., against 2.65c.; plain wire, 3c., against 3.25c.; nails, \$3.10, against \$3.25; hoops, 2.85c., against 3.05c.; blue annealed sheets, 3.20c., against 3.55c.; black sheets, 4.15c., against 4.35c.; galvanized sheets, 5.35c., against 5.70c. Thus the declines range in general from \$4 to \$8 a ton.

In practically all the commodities mentioned there are mills willing to accept orders, if of reasonable size, at still lower prices. It is believed, for instance, that on a 5,000-ton order for plates 2c. could be done.

The trade generally attributes the starting of the break in the market to the Midvale Steel & Ordnance Co., which undoubtedly was the first interest to quote deep cuts to the trade at large. Inasmuch, however, as other independents within a few days decided also to make large concessions, even though they observed the Midvale company was not getting much business, the distinction is not an important one. It looks as though others would have taken the initiative within a short time if Midvale had not done so.

#### ATTITUDE OF INDEPENDENTS

The usual philosophy of steel makers, in a period of light demand, is that there is no use in reducing prices when buyers are not ready to take hold. Such a philosophy applied to the present situation would not countenance the price concessions that are so readily available. There is,

however, a difference, a situation that never before existed when the market was dull, the difference being that the Steel Corporation has been running at a high rate. From Dec. 1 to Jan. 15 the Steel Corporation produced at the rate of approximately 92 per cent of capacity, while the independents averaged a rate of scarcely more than 25 per cent, certainly not more than 30 per cent. In 1908 prices were maintained fairly well, but at that time the Steel Corporation's operations did not average as high as those of the independents. That was known at the time, and can be seen in the official statistics since compiled. Possibly the independents had no objection to the Steel Corporation running so well when they were almost idle, except for one circumstance, that consumers were getting the product. What the consumers were securing from the Steel Corporation they had no occasion to get from some other producer. Some independents felt that a redistribution, or a fresh start, was desirable from their viewpoint.

The Steel Corporation's operations were marked for a decline, but the break in independent steel prices is now causing the decline to be more rapid. The corporation operated at about 92 per cent of capacity in the fore part of January, and at somewhat under 90 per cent toward the close of the month. Its operations this week may be estimated at about 80 per cent, and the present outlook is that operations will decline at the rate of several per cent a week. Even at the beginning of the year some of the corporation customers were receiving more steel than they were currently consuming. With prices breaking, these buyers are unwilling to continue piling steel, and suspensions of shipment have become common. In some commodities the corporation's decrease in production in the next few weeks will not be fully equal to the decrease in shipping instructions, since the corporation can make stocks. This is quite feasible, as the corporation's production costs, while high, are not really excessive. The independents as a rule allowed their costs to mount so in 1920, when the money came in so easily, that it would be quite unbusinesslike now to make any stocks.

#### THE FUTURE

The first recasting of the steel market will require only a few weeks. Depending on the volume of buying, now too light to make a real market, the independents may develop something like a stable market. Then there is the Steel Corporation to be considered. It is not a question of whether the corporation will reduce its prices, but a question of when it will do so. The corporation may decide to reduce its prices when its operations get down to 60 per cent or 50 per cent or it may not reduce until it is operating at a lower rate than the independents.

As to demand, there will necessarily be an increase in the near future, for the present demand, in the open market, is almost nothing. The steel industry's capacity in finished rolled steel is in the neighborhood of 150,000 net tons per working day. The buying this week is not at a rate 10 per cent of that. The possibility of full operation again is such an indefinite one that it is not the subject of prediction or even conjecture. The nearby future presents a prospect of all mills striving to reduce their production costs, both for the purpose of being able to take orders without loss and for the purpose of broadening the demand for steel, which as a construction material must be at attractive prices. To illustrate, an estimate is made that of all the large skeleton steel or skyscraper office and hotel buildings in the country 85 per cent are built with steel contracted for when the steel market was at one of its low points.

#### PIG IRON

Since Jan. 1 the nominal market on bessemer iron has been \$32 valley, basic being nominally \$30. Of late it has been well known that steel interests, having surplus pig iron, would sell at much less, but actual quotations have been lacking. A large valley merchant interest has now voluntarily announced its asking prices at \$29 for bessemer and \$27.50 for basic, f.o.b. valley furnaces. There is no inquiry. Foundry iron remains nominally quotable at \$28 valley.

### General Chemicals

#### CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0 55 - \$0 60
Acetone.....lb.	\$0 13 - \$0 13	1 13 - 1 14
Acid, acetic, 28 per cent.....100 lbs.	3 00 - 3 25	3 50 - 3 75
Acetic, 56 per cent.....100 lbs.	6 00 - 6 25	6 50 - 6 75
Acetic, glacial, 99 1/2 per cent, carboys, 100 lbs.	10 50 - 11 00	11 25 - 11 50
Boric, crystals.....lb.	14 - 15	15 - 16
Boric, powder.....lb.	15 - 16	17 - 18
Citric.....lb.		46 - 48
Hydrochloric.....100 lb.	1 60 - 1 75	1 85 - 2 25
Hydrofluoric, 52 per cent.....lb.	15 - 16	16 - 18
Lactic, 44 per cent tech.....lb.	10 - 11	11 - 12
Lactic, 22 per cent tech.....lb.	04 - 05	06 - 07
Molybdenic, C. P.....lb.	4 00 - 4 50	4 50 - 5 00
Muriatic, 20 deg. (see hydrochloric).....lb.		
Nitric, 40 deg.....lb.	07 - 07	08 - 08
Nitric, 42 deg.....lb.	08 - 09	09 - 10
Oxalic, crystals.....lb.	18 - 18	18 - 19
Phosphoric, Ortho, 50 per cent solution lb.	15 - 15	16 - 16
Picric.....lb.	30 - 32	35 - 40
Pyrogallol, resublimed.....lb.		2 30 - 2 40
Sulphuric, 60 deg., tank cars.....ton		14 00 - 15 00
Sulphuric, 60 deg., drums.....ton		
Sulphuric, 66 deg., tank cars.....ton	18 00 - 19 00	
Sulphuric, 66 deg., drums.....ton	21 00 - 22 00	22 50 - 23 00
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	23 00 - 24 00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	25 00 - 26 00	26 50 - 27 00
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	32 00 - 35 00	40 00 - 45 00
Tannic, U. S. P.....lb.		1 15 - 1 25
Tannic (tech.).....lb.	45 - 47	48 - 50
Tartaric, crystals.....lb.		35 - 38
Tungstic, per lb. of WO.....gal.		1 00 - 1 20
Alcohol, Ethyl.....gal.		5 25 - 5 50
Alcohol, Methyl (see methanol).....gal.		
Alcohol, denatured, 188 proof.....gal.		54 - 57
Alcohol, denatured, 190 proof.....gal.		58 - 60
Alum, ammonia lump.....lb.	04 - 04	05 - 05
Alum, potash lump.....lb.	05 - 06	06 - 07
Alum, chrome lump.....lb.	13 - 13	14 - 14
Aluminum sulphate, commercial.....lb.	02 - 02	02 - 03
Aluminum sulphate, iron free.....lb.	03 - 03	03 - 03
Aqua ammonia, 26 deg., drums (750 lb.) lb.	07 - 07	07 - 08
Ammonia, anhydrous, cyl. (100-150 lb.) lb.	30 - 32	33 - 35
Ammonium carbonate, powder.....lb.	11 - 11	12 - 12
Ammonium chloride, granular (white salamoniac) (nominal).....lb.	07 - 07	08 - 08
Ammonium chloride, granular (gray salamoniac).....lb.	09 - 09	09 - 10
Ammonium nitrate.....lb.	09 - 09	10 - 10
Ammonium sulphate.....100 lb.	3 25 - 3 35	3 40 - 3 60
Amylacetate.....gal.		4 25 - 4 50
Amylacetate tech.....gal.		3 50 - 3 75
Arsenic oxide, (white arsenic).....lb.	10 - 10	10 - 11
Arsenic, sulphide, powdered (red arsenic) lb.	14 - 14	15 - 15
Barium chloride.....ton	65 00 - 70 00	75 00 - 80 00
Barium dioxide (peroxide).....lb.	24 - 25	26 - 27
Barium nitrate.....lb.	10 - 10	10 - 11
Barium sulphate (precip.) (blanc fixe) lb.	04 - 05	05 - 06
Bleaching powder (see calc. hypochlorite).....lb.		
Blue vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Brimstone (see sulphur, roll).....lb.		
Bromine.....lb.	50 - 52	54 - 56
Calcium acetate.....100 lbs.	2 00 - 2 05	
Calcium carbide.....lb.	04 - 04	04 - 05
Calcium chloride, fused, lump.....ton	27 00 - 29 00	30 00 - 32 00
Calcium chloride, granulated.....lb.	01 - 02	02 - 02
Calcium hypochlorite (bleach'g powder) lb.	02 - 03	03 - 03
Calcium peroxide.....lb.		1 00 - 1 10
Calcium phosphate, monobasic.....lb.		15 - 16
Camphor.....lb.		75 - 80
Carbon bisulphide.....lb.	08 - 08	09 - 09
Carbon tetrachloride, drums.....lb.	11 - 11	12 - 12
Carbonyl chloride (phosgene).....lb.		75 - 1 00
Caustic potash (see potassium hydroxide) lb.		
Caustic soda (see sodium hydroxide).....lb.		
Chlorine, gas, liquid-cylinders (100 lb.) lb.	09 - 09	10 - 10
Chloroform.....lb.		38 - 40
Cobalt oxide.....lb.		3 00 - 3 10
Copperas (see iron sulphate).....lb.		
Copper carbonate, green precipitate.....lb.	22 - 22	24 - 25
Copper cyanide.....lb.		50 - 60
Copper sulphate, crystals.....lb.	06 - 06	06 - 07
Cream of tartar (see potassium bitartrate) lb.		
Epsom salt (see magnesium sulphate).....lb.		
Ethyl Acetate Com. 85%.....gal.		1 05 - 1 10
Ethyl Acetate pure (acetic ether 98% to 100%).....gal.		
Formaldehyde, 40 per cent.....lb.	17 - 17	18 - 18
Fusel oil, ref.....gal.		3 50 - 3 60
Fusel oil, crude.....gal.		2 75 - 3 00
Glauber's salt (see sodium sulphate).....lb.		
Glycerine, C. P. drums extra.....lb.		20 - 21
Iodine, resublimed.....lb.		3 85 - 4 00
Iron oxide, red.....lb.		10 - 20
Iron sulphate (copperas).....100 lb.	1 25 - 1 50	1 75 - 2 00
Lead acetate, normal.....lb.		14 - 16
Lead arsenate (paste).....lb.	11 - 12	12 - 13
Lead nitrate.....lb.		15 - 20
Litharge.....lb.	08 - 09	09 - 10
Lithium carbonate.....lb.		1 25 - 1 30
Magnesium carbonate, technical.....lb.	10 - 11	11 - 12
Magnesium sulphate, U. S. P.....100 lb.	2 00 - 2 50	
Magnesium sulphate, commercial, 100 lb.		1 50 - 1 75
Methanol, 95%.....gal.		1 28 - 1 30
Methanol, pure.....gal.		1 60 - 1 65
Nickel salt, double.....lb.		12 - 12
Nickel salt, single.....lb.		13 - 13
Phosgene (see carbonyl chloride).....lb.		
Phosphorus, red.....lb.	45 - 46	47 - 50
Phosphorus, yellow.....lb.		35 - 37
Potassium bichromate.....lb.	14 - 14	14 - 15

	Carlots	Less Carlots
Potassium bitartrate (cream of tartar) . . . lb.	\$ 30 - \$ 35	\$ 20 - \$ 35
Potassium bromide, granular . . . lb.	35 - 40	45 - 50
Potassium carbonate, U. S. P. . . lb.	08 - 08½	09 - 10
Potassium carbonate, crude . . . lb.	08 - 10	11 - 18
Potassium chlorate, crystals . . . lb.	12 - 12½	13 - 13½
Potassium cyanide . . . lb.	70 00 - 75 00	3 00 - 3 20
Potassium hydroxide (caustic potash) . . . lb.	09½ - 09½	10 - 12½
Potassium iodide . . . lb.	48 - 50	52 - 60
Potassium nitrate . . . lb.	50 - 52	53 - 55
Potassium permanganate . . . lb.	28 - 29	30 - 32
Potassium prussiate, red . . . lb.		2 25
Potassium prussiate, yellow . . . lb.		
Potassium sulphate (powdered) . . . per unit		
Rochelle salts (see sodium potas tartrate)		
Salammoniac (see ammonium chloride)		
Salt soda (see sodium carbonate)		
Salt cake . . . ton	32 00 - 33 00	
Silver cyanide . . . oz.	1 25 - 44	
Silver nitrate . . . oz.	43½ - 44	
Soda ash, light . . . 100 lb.	2 10 - 2 20	2 25 - 2 40
Soda ash, dense . . . 100 lb.	2 20 - 2 30	2 40 - 2 60
Sodium acetate . . . lb.	05½ - 05½	06 - 06½
Sodium bicarbonate . . . 100 lb.	2 50 - 2 75	3 00 - 3 25
Sodium bichromate . . . lb.	08½ - 08½	08½ - 09
Sodium bisulphate (nitre cake) . . . ton	7 00 - 7 50	8 00 - 11 00
Sodium bisulphate powdered, U. S. P. . . lb.	05½ - 05½	06 - 06½
Sodium borate (borax) . . . lb.	08½ - 08½	08½ - 09
Sodium carbonate (salt soda) . . . 100 lb.	2 00 - 2 25	2 50 - 2 75
Sodium chloride . . . lb.	10 - 10½	10½ - 11
Sodium cyanide, 96-98 per cent . . . lb.	20 - 21	22 - 28
Sodium fluoride . . . lb.	13½ - 14	14½ - 15
Sodium hydroxide (caustic soda) . . . 100 lb.	3 85 - 3 90	3 95 - 4 25
Sodium hyposulphite . . . lb.		03½ - 04
Sodium nitrate . . . 100 lb.	2 85 -	3 00 -
Sodium nitrite . . . lb.	06 - 06½	06½ - 07
Sodium peroxide, powdered . . . lb.	30 - 31	32 - 34
Sodium phosphate, dibasic . . . lb.	03½ - 04½	04½ - 05
Sodium potassium tartrate (Rochelle salts) . . . lb.		29 - 31
Sodium prussiate, yellow . . . lb.	16½ - 16½	16½ - 17
Sodium silicate, solution (40 deg.) . . . lb.	1 10 - 1 15	1 20 - 1 40
Sodium silicate, solution (60 deg.) . . . lb.	02½ - 03	03½ - 03½
Sodium sulphate crystals (Glauber's salt) 100 lbs.	1 75 - 2 00	2 25 - 2 50
Sodium sulphide, crystal, 60-62 per cent (conc.) lb.	05 - 05½	05½ - 06
Sodium sulphite, crystals . . . lb.	04 - 04½	04½ - 05
Strontium nitrate, powdered . . . lb.	17½ - 18	18½ - 18½
Sulphur chloride, red . . . lb.	07 - 07½	07½ - 08
Sulphur, crude . . . ton	16 00 - 20 00	
Sulphur dioxide, liquid, cylinders . . . lb.	08 - 08½	08½ - 09
Sulphur (sublimed), flour . . . 100 lb.		2 25 - 3 10
Sulphur, roll (brimstone) . . . 100 lb.		2 00 - 2 75
Tin bichloride, 50 per cent . . . lb.	18 - 19	
Tin oxide . . . lb.		45 - 47
Zinc carbonate, precipitate . . . lb.	16 - 18	19 - 20
Zinc chloride, gran . . . lb.	11 - 11½	11½ - 12
Zinc cyanide . . . lb.	45 - 49	50 - 60
Zinc dust . . . lb.	12 - 13	13½ - 14
Zinc oxide, XX . . . lb.	08½ - 09	09½ - 11
Zinc sulphate . . . lb.	03½ - 03½	04 - 06

## Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude . . . lb.	\$1 10 - \$1 15
Alpha-naphthol, refined . . . lb.	1 45 - 1 50
Alpha-naphthylamine . . . lb.	38 - 40
Aniline oil, drums extra . . . lb.	21 - 27
Aniline salts . . . lb.	27 - 30
Anthracene, 80% in drums (100 lb.) . . . lb.	75 - 1 00
Benzaldehyde U. S. P. . . lb.	1 00 - 1 50
Benidine, base . . . lb.	95 - 1 05
Benidine sulphate . . . lb.	80 - 90
Benzoic acid, U. S. P. . . lb.	70 - 75
Benzoate of soda, U. S. P. . . lb.	70 - 80
Benzene, pure, water-white, in drums (100 gal.) . . . gal.	30 - 35
Benzene, 90%, in drums (100 gal.) . . . gal.	28 - 32
Benzyl chloride, 95-97%, refined . . . lb.	30 - 35
Benzyl chloride, tech . . . lb.	25 - 30
Beta-naphthol benzoate . . . lb.	3 50 - 4 00
Beta-naphthol, sublimed . . . lb.	70 - 75
Beta-naphthol, tech . . . lb.	32 - 35
Beta-naphthylamine, sublimed . . . lb.	2 25 - 2 40
Cresol, U. S. P., in drums (100 lb.) . . . lb.	16 - 18
Ortho-cresol, in drums (100 lb.) . . . lb.	23 - 25
Cresylic acid, 97-99%, straw color, in drums . . . gal.	95 - 1 00
Cresylic acid, 75-97%, dark, in drums . . . gal.	90 - 95
Cresylic acid, 50%, first quality, drums . . . gal.	60 - 65
Dichlorobenzene . . . lb.	06 - 09
Diethylaniline . . . lb.	1 20 - 1 30
Dimethylaniline . . . lb.	55 - 65
Dinitrobenzene . . . lb.	30 - 32
Dinitrochlorobenzene . . . lb.	25 - 30
Dinitronaphthalene . . . lb.	33 - 35
Dinitrophenol . . . lb.	40 - 45
Dinitrotoluene . . . lb.	25 - 30
Dip oil, 25% tar acids, car lots, in drums . . . gal.	37 - 40
Diphenylamine . . . lb.	60 - 70
H-acid . . . lb.	1 30 - 1 50
Meta-phenylenediamine . . . lb.	1 25 - 1 30
Monochlorobenzene . . . lb.	14 - 16
Monothylaniline . . . lb.	1 75 - 2 00
Naphthalene crushed, in bbls. (250 lb.) . . . lb.	07 - 08
Naphthalene, flake . . . lb.	08 - 08½
Naphthalene, balls . . . lb.	08 - 08½
Naphthalonic acid, crude . . . lb.	70 - 75
Nitrobenzene . . . lb.	12 - 15
Nitronaphthalene . . . lb.	30 - 35
Nitro-toluene . . . lb.	18 - 25
Ortho-amidophenol . . . lb.	3 20 - 3 75
Ortho-dichlorobenzene . . . lb.	15 - 20
Ortho-nitro-phenol . . . lb.	75 - 80
Ortho-nitro-toluene . . . lb.	20 - 24
Ortho-toluidine . . . lb.	25 - 30
Para-amidophenol, base . . . lb.	1 90 - 2 00
Para-amidophenol, HCl . . . lb.	2 10 - 2 20

Para-dichlorobenzene . . . lb.	15 - 25
Paranitroaniline . . . lb.	90 - 95
Para-nitrotoluene . . . lb.	90 - 1 05
Para-phenylenediamine . . . lb.	1 90 - 2 00
Para-toluidine . . . lb.	1 30 - 1 60
Phthalic anhydride . . . lb.	55 - 60
Phenol, U. S. P., drums (dest.), (240 lb.) . . . lb.	10 - 12
Pyridine . . . gal.	2 00 - 3 50
Resorcinol, technical . . . lb.	1 85 - 2 00
Resorcinol, pure . . . lb.	2 30 - 2 50
Salicylic acid, tech., in bbls. (110 lb.) . . . lb.	23 - 25
Salicylic acid, U. S. P. . . lb.	27 - 30
Salol . . . lb.	85 - 95
Solvent naphtha, water-white, in drums, 100 gal. . . gal.	28 - 32
Solvent naphtha, crude, heavy, in drums, 100 gal. . . gal.	16 - 18
Sulphanilic acid, crude . . . lb.	30 - 35
Tolidine . . . lb.	1 35 - 1 45
Toluidine, mixed . . . lb.	40 - 45
Toluene, in tank cars . . . gal.	28 - 32
Toluene, in drums . . . gal.	30 - 35
Xylidines, drums, 100 gal. . . lb.	40 - 45
Xylene, pure, in drums . . . gal.	42 - 45
Xylene, pure, in tank cars . . . gal.	45 - 45
Xylene, commercial, in drums, 100 gal. . . gal.	33 - 35
Xylene, commercial, in tank cars . . . gal.	30 - 35

## Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark . . . lb.	\$0 24 - \$0 26
Beeswax, refined, light . . . lb.	27 - 28
Beeswax, white pure . . . lb.	40 - 45
Carnauba, Florida . . . lb.	71 - 72
Carnauba, No. 2, North Country . . . lb.	30 - 32
Carnauba, No. 3, North Country . . . lb.	18 - 19
Japan . . . lb.	19 - 20
Montan, crude . . . lb.	07 - 08
Paraffine waxes, crude match wax (white) 105-110 m.p. . . lb.	04½ - 04½
Paraffine waxes, crude, scale 124-126 m.p. . . lb.	04 - 04½
Paraffine waxes, refined, 118-120 m.p. . . lb.	04½ - 05½
Paraffine waxes, refined, 125 m.p. . . lb.	05 - 05½
Paraffine waxes, refined, 128-130 m.p. . . lb.	06 - 06½
Paraffine waxes, refined, 133-135 m.p. . . lb.	07 - 07½
Paraffine waxes, refined, 135-137 m.p. . . lb.	09 - 09½
Stearic acid, single pressed . . . lb.	12 - 12½
Stearic acid, double pressed . . . lb.	12½ - 13
Stearic acid, triple pressed . . . lb.	13½ - 14

## Flotation Oils

All prices are f.o.b. New York unless otherwise stated, and are based on earload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp.gr., 0.930-0.940 . . . gal.	\$1 70
Pine oil, pure, dest. dist. . . gal.	1 60
Pine tar oil, ref., sp.gr. 1.025-1.035 . . . gal.	48
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla. . . gal.	35
Pine tar oil, double ref., sp.gr. 0.965-0.990 . . . gal.	75
Pine tar, ref., thin, sp.gr., 1.080-1.960 . . . gal.	36
Turpentine, crude, sp. gr., 0.900-0.970 . . . gal.	1 20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990 . . . gal.	37
Pine wood creosote, ref. . . gal.	55

## Naval Stores

The following prices are f.o.b. New York for earload lots.

Rosin B-1, bbl. . . 280 lb.	\$7 25 -
Rosin E-1, . . . 280 lb.	7 25 -
Rosin K-N, . . . 280 lb.	7 25 -
Rosin W. G. W. W. . . 280 lb.	7 50 -
Wood rosin, bbl. . . 280 lb.	7 75 -
Spirits of turpentine . . . gal.	58 -
Wood turpentine steam dist. . . gal.	56 -
Wood turpentine, dest. dist. . . gal.	55 -
Pine tar pitch, bbl. . . 200 lb.	8 50 -
Tar, kiln burned, bbl. (500 lb.) . . . bbl.	15 00 -
Retort tar, bbl. . . 500 lb.	15 00 -
Rosin oil, first run . . . gal.	50 -
Rosin oil, second run . . . gal.	52 -
Rosin oil, third run . . . gal.	60 -

## Solvents

73-76 deg., steel bbls. (85 lb.) . . . gal.	\$0 41
70-72 deg., steel bbls. (85 lb.) . . . gal.	39
68-70 deg., steel bbls. (85 lb.) . . . gal.	38
V. M. and P. naphtha, steel bbls. (85 lb.) . . . gal.	30

## Crude Rubber

Para-Upriver fine . . . lb.	\$0 17 - \$0 18
Upriver coarse . . . lb.	13 - 14
Upriver caucho ball . . . lb.	14 - 14½
Plantation—First latex crepe . . . lb.	19 -
Ribbed smoked sheets . . . lb.	18 -
Brown crepe, thin, clean . . . lb.	18 -
Amber crepe No. 1 . . . lb.	20 -

## Oils

## VEGETABLE

The following prices are f.o.b. New York for earload lots.

Castor oil, No. 3, in bbls. . . lb.	\$0 09½ - \$0 09½
Castor oil, AA, in bbls. . . lb.	10 - 11
China wood oil, in bbls. (f.o.b. Pac. coast) . . . lb.	08 - 08½
Cocanut oil, Ceylon grade, in bbls. . . lb.	11 - 12
Cocanut oil, Cochon grade, in bbls. . . lb.	12 - 12½
Corn oil, crude, in bbls. . . lb.	08½ - 09
Cottonseed oil, crude (f. o. b. mill) . . . lb.	05½ - 06
Cottonseed oil, summer yellow . . . lb.	08 - 08½
Cottonseed oil, winter yellow . . . lb.	09 - 09½
Linseed oil, raw, car lots (domestic) . . . gal.	70 - 71
Linseed oil, raw, tank cars (domestic) . . . gal.	63 -
Linseed oil, boiled, car lots (domestic) . . . gal.	72 - 73

Olive oil, commercial	gal	\$2 40	\$2 60
Palm, Lagos	lb.	.07	.07
Palm, Niger	lb.	.06	.06
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.06	.07
Peanut oil, refined, in bbls.	lb.	.12	.13
Rapeseed oil, refined in bbls.	gal	1 05	1 10
Rapeseed oil, blown, in bbls.	gal	1 15	1 20
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.07	.08
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.04	....

## FISH

Light pressed menhaden	gal.	\$0 46	\$0 48
Yellow bleached menhaden	gal.	.48	.50
White bleached menhaden	gal.	.50	.52
Blown menhaden	gal.	.85	....

## Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	\$24 00	30 00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22 00	26 00
Barytes, crude, 88% or 94% ba., Kings Creek	net ton	10 00	12 00
Barytes, floated, f.o.b. St. Louis	net ton	26 50	28 00
Barytes, crude, first grade, Missouri	net ton	10 00	....
Blane fixe, dry	lb.	.05	.05
Blane fixe, pulp	net ton	50 00	60 00
Casein	lb.	.14	.18
Chalk, domestic, extra light	lb.	.05	.06
Chalk, domestic, light	lb.	.04	.05
Chalk, domestic, heavy	lb.	.04	.05
Chalk, English, extra light	lb.	.05	.07
Chalk, English, light	lb.	.05	.06
Chalk, English, dense	lb.	.04	.05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8 00	10 00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12 00	15 00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18 00	22 00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8 00	12 00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15 00	40 00
China clay (kaolin), imported, lump	net ton	23 00	25 00
China clay (kaolin), imported, powdered	net ton	30 00	35 00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8 00	14 00
Feldspar, crude, f.o.b. Maine	net ton	7 50	10 00
Feldspar, ground, f.o.b. Maine	net ton	21 00	23 00
Feldspar, ground, f.o.b. North Carolina	net ton	17 00	21 00
Feldspar, ground, f.o.b. N. Y. State	net ton	17 00	21 00
Feldspar, ground, f.o.b. Baltimore	net ton	27 00	30 00
Fullers earth, f.o.b. Mines	net ton	16 00	17 00
Fullers earth, granular, f.o.b. Fla.	net ton	25 00	....
Fullers earth, powdered, f.o.b. Fla.	net ton	18 00	....
Fullers earth, imported, powdered	net ton	35 00	40 00
Graphite, crucible, 90% carbon, Ashland, Ala.	lb.	.07	.09
Graphite, crucible, 85% carbon, Ashland, Ala.	lb.	.11	.40
Graphite, higher lubricating grades	lb.	.04	.50
Pumice stone, imported, lump	lb.	.05	.05
Pumice stone, domestic lump	lb.	.06	.07
Pumice stone, ground	lb.	.06	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	....	10 00
Quartz (acid tower) 1 1/2 to 2 in., f.o.b. Baltimore	net ton	....	14 00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	....	17 00
Quartz, lump, f.o.b. North Carolina	net ton	5 00	7 50
Shellac, orange fine	lb.	.65	....
Shellac, orange superfine	lb.	.70	....
Shellac, A. C. garnet	lb.	.57	....
Shellac, T. N.	lb.	.55	....
Soapstone	ton	12 00	15 00
Sodium chloride	long ton	....	17 00
Talc, paper-making grades, f.o.b. Vermont	ton	12 00	22 00
Talc, roofing grades, f.o.b. Vermont	ton	9 50	15 00
Talc, rubber grades, f.o.b. Vermont	ton	12 00	18 00
Talc, powdered, Southern, f.o.b. cars	ton	12 00	15 00
Talc, imported	ton	40 00	50 00
Talc, California talcum powder grade	ton	20 00	45 00

## Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	1,000	160	....
Chrome brick, f.o.b. Eastern shipping points	net ton	80-100	....
Chrome cement, 40-45% Cr <sub>2</sub> O <sub>3</sub> , sacks, in car lots, f.o.b. Eastern shipping points	net ton	45-50	....
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	55-60	....
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	45-50	....
Magnesite brick, 9-in. straight	net ton	100	....
Magnesite brick, 9-in. arches, wedges and keys	net ton	105	....
Magnesite brick, 9-in. sizes, f.o.b. Chicago district	net ton	120	....
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	65-70	....
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	56-61	....
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	50-66	....

## Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	\$200 00	\$225 00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, carlots	lb.	16	....
Ferrochrome per lb. of Cr. contained, 4-6% carbon, carlots	lb.	16	17
Ferromanganese, 76-80% Mn, domestic	gross ton	95 00	100 00
Ferromanganese, 76-80% Mn, English	gross ton	95 00	100 00
Spiegelisen, 18-22% Mn	gross ton	38 00	40 00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2 00	2 50
Ferrosilicon, 10-15%	gross ton	50 00	55 00
Ferrosilicon, 50%	gross ton	80 00	85 00
Ferrosilicon, 75%	gross ton	150 00	155 00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	55	60
Ferrouranium, 35-50% of U, per lb. of U content	lb.	7 00	....
Ferrovandium, 30-40% per lb. of contained V	lb.	5 00	5 25

## Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content, less than 2% Fe <sub>2</sub> O <sub>3</sub> , up to 20% silica, not more than H 4% moisture	gross ton	\$10 00	\$11 00
Chrome ore, Calif. concentrates, 50% min. Cr <sub>2</sub> O <sub>3</sub>	unit	.55	.60
Chrome ore, 50% Cr <sub>2</sub> O <sub>3</sub> , f.o.b. Atlantic seaboard	unit	50	55
Coke, foundry, f.o.b. ovens	net ton	6 00	6 50
Coke, furnace, f.o.b. ovens	net ton	4 50	5 00
Coke, petroleum, refinery, Atlantic seaboard	net ton	11 50	12 00
Fluorspar, lump, f.o.b. Heathden, New Mexico	net ton	17 50	....
Fluorspar, standard, domestic washed gravel	net ton	22 50	25 00
Kentucky and Illinois mines	net ton	.01	.01
Ilmenite, 52% TiO <sub>2</sub> , per lb. ore	unit	35	40
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	gross ton	60 00	65 00
Manganese ore, chemical (MnO <sub>2</sub> )	lb.	.55	.60
Molybdenite, 85% MoS <sub>2</sub> , per lb. of MoS <sub>2</sub> , N. Y.	unit	30 00	....
Monazite, per unit of ThO <sub>2</sub> , c.i.f. Atlantic seaport	unit	.16	....
Pyrites, Spanish, fines, c.i.f. Atlantic seaport	unit	.16	....
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12	.14
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	.15	....
Rutile, 95% TiO <sub>2</sub> per lb. ore	lb.	3 00	3 25
Tungsten, scheelite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> (nominal)	unit	3 00	3 25
Tungsten, wolframite, 60% WO <sub>3</sub> and over, per unit of WO <sub>3</sub> , N. Y. C.	unit	3 00	3 25
Uranium ore (carnotite) per lb. of U <sub>3</sub> O <sub>8</sub>	lb.	1 50	2 50
Uranium oxide, 96% per lb. contained U <sub>3</sub> O <sub>8</sub>	lb.	2 25	2 50
Vanadium pentoxide, 99%	lb.	12 00	14 00
Vanadium ore, per lb. of V <sub>2</sub> O <sub>5</sub> contained	lb.	1 50	....
Zircon, washed, iron free	lb.	.03	....

## Non-Ferrous Metals

New York Markets

Cents per lb.

Copper, electrolytic	13 00
Aluminum, 98 to 99 per cent	28 3/4 @ 28 5
Antimony, wholesale lots, Chinese and Japanese	5 25
Nickel, ordinary (ingot)	41 00
Nickel, electrolytic	44 00
Monel metal, spot and blocks	35
Monel metal, ingots	38
Monel metal, sheet bars	40
Tin, 5-ton lots	31 50
Lead, New York, spot	4 50
Lead, E. St. Louis, spot	4 10
Zinc, spot, New York	6 00
Zinc, spot, E. St. Louis	4 90 @ 5 00

## OTHER METALS

Silver (commercial)	oz.	\$0 66 1/2
Cadmium	lb.	1 40 @ 1 50
Bismuth (500 lb. lots)	lb.	2 25 @ 2 35
Cobalt	lb.	4 50
Magnesium (f.o.b. Philadelphia)	lb.	1 25
Platinum	oz.	70 00
Iridium	oz.	325 00
Palladium	oz.	65 00 @ 70 00
Mercury	75 lb.	50 00

## FINISHED METAL PRODUCTS

Warehouse Price  
Cents per lb.

Copper sheets, hot rolled	21 00
Copper bottoms	33 00
Copper rods	28 00
High brass wire and sheets	18 75
High brass rods	16 75
Low brass wire and sheets	27 50
Low brass rods	18 50
Brazed brass tubing	35 25
Brazed bronze tubing	40 50
Seamless copper tubing	25 00
Seamless high brass tubing	24 00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York				Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper, heavy and crucible	11 50	18 50	10 00	10 50	....	....	....	....
Copper, heavy and wire	11 00	16 50	9 50	9 50	....	....	....	....
Copper, light and bottoms	9 00	14 50	9 00	8 50	....	....	....	....
Lead, heavy	4 00	7 25	4 00	4 00	....	....	....	....
Lead, tea	3 00	5 25	3 00	3 00	....	....	....	....
Brass, heavy	7 00	9 50	7 00	10 00	....	....	....	....
Brass, light	5 50	8 00	5 00	5 50	....	....	....	....
No. 1 yellow brass turnings	6 00	9 50	5 50	6 00	....	....	....	....
Zinc	4 00	5 00	3 00	3 50	....	....	....	....

## Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York			Cleveland			Chicago		
	Current	One Month Ago	One Year Ago	Current	One Month Ago	One Year Ago	Current	One Month Ago	One Year Ago
Structural shapes	\$3 73	\$3 80	\$3 47	\$3 58	\$3 37	\$3 58	\$3 47	\$3 48	\$3 52
Soft steel bars	3 93	3 70	3 52	3 34	3 27	3 48	3 52	3 48	3 52
Soft steel bar shapes	3 93	3 70	3 52	3 48	3 27	3 48	3 52	3 48	3 52
Soft steel bands	4 33	4 65	4 22	6 25	....	....	....	....	....
Plates, 1 to 1 in. thick	3 93	4 00	3 67	3 78	3 57	3 78	3 67	....	....

\*Add 10c per 100 lb. for trucking to Jersey City and 15c for delivery in New York and Brooklyn

# Industrial

Financial, Construction and Manufacturers' News

## Construction and Operation

### Arkansas

**FORDYCE**—The Magnolia Petroleum Co. has awarded a contract to Schneider & Camp, Pine Bluff, Ark., for the rebuilding of the portion of its plant, recently damaged by fire with loss reported in excess of \$75,000.

### California

**PITTSBURG**—The Pioneer Rubber Co., San Francisco, has awarded a contract to the Cahill & Vensano Co., 110 Sutter Street, San Francisco, for the erection of a new 1-story, reinforced-concrete plant at Pittsburg, to cost about \$50,500. Construction will be placed under way at once.

### Connecticut

**NEW HAVEN**—The Seamless Rubber Co., Hallock Ave., manufacturer of rubber goods, has filed plans for the erection of an addition to its plant, including improvements to present works to cost about \$400,000, including machinery.

### Florida

**FERNANDINA**—The Seminole Fertilizer & Oil Co. has tentative plans under way for the rebuilding of the portion of its plant recently destroyed by fire.

**JACKSONVILLE**—The Florida Paint & Cement Co., recently organized, has leased a local building for the establishment of a factory for the manufacture of technical paints. Local offices have been arranged at 302 Hill Bldg. H. A. Wheeler is president.

### Georgia

**SAVANNAH**—The Southern Cotton Oil Co., 120 Broadway, has commenced the erection of its proposed new plant at Savannah for the manufacture of paint products. The factory with machinery is estimated to cost in excess of \$300,000.

### Illinois

**ALTON**—The Consolidated Chemical Products Co. is planning for the erection of an addition to its local plant to be used for the production of muriatic acid and kindred specialties.

### Iowa

**HAMPTON**—The Hampton Brick & Tile Co. is having plans prepared for the erection of a new brick and tile manufacturing plant with main building, 1-story, 40x200 ft., and a number of smaller structures, estimated to cost about \$250,000, including machinery. Claude Smith, Sheffield, Ia., is architect. J. C. Powers is secretary.

### Louisiana

**LAKE CHARLES**—The Builders' Products Co. has plans under way for the erection of a new plant for the manufacture of hollow tile, paving brick and other burned clay products. Samuel Cummings is president.

### Maryland

**BALTIMORE**—The Davison Chemical Co., Garrett Bldg., has arranged for a bond issue of \$2,000,000, the proceeds to be used for financing, operation and expansion. The company specializes in the manufacture of sulphuric acid, acid phosphate and other heavy chemicals. C. Wilbur Miller is president.

**BALTIMORE**—The Rasin - Monumental Co., National Marine Bank Bldg., a subsidiary of the Virginia-Carolina Chemical Co., Richmond, Va., specializing in the manufacture of fertilizers, has completed plans for the erection of its proposed new plant on the Patapsco River, and will take bids at an early date. The plant will be equipped for an annual production of 125,000 tons, and is estimated to cost about \$1,000,000, including machinery.

**BALTIMORE**—The Central Chemical Co., Pennington Ave., manufacturer of fertil-

izer products, has preliminary plans under way for the construction of a new building at its works. The company recently increased its capital from \$500,000 to \$1,000,000. M. H. Landers is head.

### Massachusetts

**MARBLEHEAD**—The United States Upper Leather Co. has awarded a contract to the E. H. Porter Co., 15 Wallis St., Peabody, Mass., for the erection of a new 1-story building, 50x150 ft., at 278 B'way, Wyoma, to be equipped as a leather buffing department. Ernest Day is general manager.

**RANDOLPH**—The Randolph Foundry Co. has commenced the construction of a new 1-story foundry on Pleasant St., 50x75 ft., to cost about \$15,000. John Ferris is head.

### Mississippi

**NITTA YUMA**—The Anguilla Cotton Oil Co. is planning for the rebuilding of the section of its plant destroyed by fire on Feb. 1, with loss estimated at about \$150,000.

### Missouri

**GERALD**—The General Chemical Co., 25 Broad St., New York, is planning to open up a new mine at its local clay properties early in the spring, making the fourth such mine in operation by the company here. Equipment will be installed.

**JEFFERSON CITY**—John C. Dyott and associates are forming a company to construct and operate a local cement mill. Details of the new plant are being arranged.

### Montana

**MILES CITY**—G. S. Bowser and B. C. Duggan are organizing a company to construct and operate a brick manufacturing plant on the Tongue River, near Fort Keogh, Mont. The plant will have an initial capacity of about 20,000 bricks daily.

### New York

**MASPEETH**—The United States Industrial Alcohol Co., 27 William St., New York, has awarded a contract to the George A. Fuller Industrial Eng. Co., 949 B'way, for the erection of its proposed new plant at Maspeeth, on site at Grand St. and Harrison Ave. The works will comprise two brick and stone buildings, estimated to cost about \$500,000 with machinery.

**NEW YORK**—The Tide Water Oil Co., 11 B'way, operating an oil refinery at Bayonne, N. J., has arranged for a bond issue of \$12,000,000, the proceeds to be used for general financing operations and extensions. R. D. Benson is president.

**BROOKLYN**—The Botts Marking Ink Co., 330 Pearl St., New York, has leased the factory at 68-76 Third St., Brooklyn, for the establishment of a new plant.

**BROOKLYN**—Constant A. Benoit, Jerome Ave., manufacturer of chemicals, has filed plans for the erection of a new 3-story plant, 151x161 ft., on Ave. Y, near E. 17th St., to cost about \$225,000 with machinery.

### North Carolina

**GLENDON**—The Tale Products Co. is planning for the erection of a new grinding plant with initial capacity of about 50 tons per day.

**WITAKERS**—The Woodard & Whitley Oil Co. is planning for the rebuilding of the portion of its plant, destroyed by fire on Jan. 22, with loss reported in excess of \$35,000.

**WILMINGTON**—The Fisheries Products Co. has preliminary plans under way for the construction of a new fertilizer plant on the Cape Fear River. A site has been selected. It is proposed to develop a capacity of about 40 cars of material per day.

### Oregon

**PORTLAND**—The Portland Vegetable Oil Mills Co. has awarded a contract to the Hurley-Mason Co. for the erection of its proposed new plant on the site of the former shipyard of the Foundation Co., estimated to cost \$450,000.

### New Jersey

**TRENTON**—The Trenton Zinc & Chemical Co., Broad St. Bank Bldg., manufacturer of zinc oxide, with plant at Fall and Fair Sts., has arranged for a stock issue of \$650,000. A portion of the proceeds will be used for plant expansion and it is proposed to increase the output from 2,000,000 lb. per year to 12,000,000. Considerable machinery will be installed for this purpose. Max Movshovitz, formerly president of the M. M. & S. Metal Co., manufacturer of similar products, is president of the Trenton Zinc & Chemical Co.

**NEWARK**—The Martin Chemical Co., 204-206 New Jersey Railroad Ave., heretofore occupying a portion of the building at this location, has purchased the entire property for increased operations. Alterations and improvements will be made, and additional equipment installed.

**METUCHEN**—The General Ceramics Co., 50 Church St., New York, will call for bids early in April for the erection of the proposed addition to its local plant, to be used for the manufacture of sanitary porcelain ware. The extension will be 1- and 2-story, 165x785 ft., and is estimated to cost about \$400,000, including equipment. Dietrich Wortmann, 116 Lexington Ave., New York, is architect.

**TRENTON**—The Bergougan Tire Co., Whitehead Rd., has resumed production at its automobile tire manufacturing plant, and plans to place a new addition in service at an early date. The structure is nearing completion, including machinery installation, and will provide considerable increased production.

### Pennsylvania

**PITTSBURGH**—The Standard Sanitary Mfg. Co., manufacturer of sanitary ware, has acquired property in the Northside district, in the vicinity of its plant, near Ontario St. The site totals about 80,000 sq. ft., and was secured for a consideration of about \$135,000. It will be used for the erection of an addition, and existing structures on the land will be razed at an early date. The company is reported to be planning for the establishment of a branch at Baltimore, Md., and negotiations are under way for the acquisition of an existing factory here. The capital was recently increased from \$12,000,000 to \$20,000,000 for expansion.

**READING**—The Atlas Mineral Products Co., recently organized with a capital of \$100,000, is planning for the operation of mining properties in the vicinity of Mertztown for the production of mineral paints, colors, compounds, etc.

### Texas

**PORT ARTHUR**—The Gulf Oil Co., operating a large local refinery, has arranged for a bond issue of \$35,000,000 for general operation, financing and extensions. The company's present plant is now averaging 22,000,000 bbl. of crude oil per year. W. L. Mellon, Mellon Natl. Bank, Pittsburgh, Pa., is president.

**CORSICANA**—The Corsicana Oil & Refining Co. has perfected plans for the immediate construction of its proposed new oil refinery, comprising the first unit, estimated to cost about \$200,000, with machinery.

**FORT BEND**—The Fort Bend Cotton Oil Co. has disposed of its local plant to the state, and in the future it will be operated by convict labor. The Prison Department is reported to be arranging plans for extensions to give employment to an increased number of men.

**DALLAS**—The Gulf Refining Co., 315 Sherman St., has awarded a contract to the Bowden Construction Co., C St., Galveston, Tex., for the erection of an addition to its local refining plant to cost about \$160,000.

**DALLAS**—The Trinity Paper Mills is completing the erection of a new plant at Commerce, Tex., and plans to install machinery and place the mill in service at an early date. It will have an initial capacity of about 20 tons of pulp per day.

**DALLAS**—The Magnolia Petroleum Co. has preliminary plans under way for the construction of a new oil refinery at Port Neches, Tex. The company has a 500-acre site here for the proposed plant, which is estimated to cost in excess of \$300,000.

### West Virginia

**HUNTINGTON**—The West Virginia Glass Mfg. Co. is planning for extensive additions in its plant for large increased capacity. Six additional blowing machines and considerable other machinery will be

installed. It is planned to triple, approximately, the initial output of the works. This is a new industry in the city.

**LUMBERPORT**—The Mound City Glass Co. is planning for extensions in its plant with the installation of considerable new machinery. It is planned to double the present output.

## New Companies

**THE D-K CHEMICAL CO.**, Nutley, N. J., has been incorporated with a capital of \$100,000 to manufacture chemical products. The incorporators are Ernest Keller, Howard M. Gensel and Gustave Kayzsch, Nutley.

**THE CONSOLIDATED PAPER & TWINE CO.**, New York, has been incorporated with a capital of \$100,000 to manufacture paper and cordage products. The incorporators are D. B. Tolins, J. G. Cohen and B. Waxenberg, 291 Broadway.

**THE ATLANTIC LEATHER CORP.**, Boston, Mass., has been incorporated with a capital of \$200,000 to manufacture leather products. The incorporators are F. H. Neamith, H. P. Mason and J. Sidney Stone, 84 State Street.

**THE S. G. PARKER CO.**, Brookline, Mass., has been incorporated with a capital of \$62,500 to manufacture chemicals and byproducts. The incorporators are Patrick J. and Donald W. Flynn, and O. A. Atkins, Brookline.

**THE COTTON STATES RUBBER CO.**, Atlanta, Ga., has been incorporated with a capital of \$500,000 to manufacture rubber goods. The incorporators are R. W. Ragin, G. J. Reuter and J. B. Anchors, Atlanta.

**THE CENTRAL STATES PAINT & VARNISH CO.**, 38 South Dearborn St., Chicago, Ill., has been incorporated with a capital of \$20,000 to manufacture paints, varnish, oils, etc. The incorporators are Charles Kramer, H. Kloth and Herman H. Sorem.

**THE BURTOID CO.**, Paterson, N. J., has been incorporated with a capital of \$100,000 to manufacture chemicals and affiliated products. The incorporators are A. Lamwers, Benjamin J. and Meyer W. Stein, 126 Market Street.

**THE SYNTHOID CO., INC.**, Boston, Mass., has been incorporated with a capital of \$50,000 to manufacture rubber products. The incorporators are Franklin W. Smith, Boston; Thomas L. Bronkhorst, Cambridge, Mass.; and Arthur V. Grimes, Brookline.

**THE IREX RUBBER CORP.**, Bound Brook, N. J., has been incorporated with a capital of \$125,000 to manufacture rubber goods. The incorporators are George O. Smalley, Bound Brook; William F. Jennings, Plainfield, N. J.; and Harry J. Lindsley, Detroit, Mich.

**THE BEACON SMELTING & REFINING CO.**, Newark, N. J., has filed notice of organization to operate a plant at 3-5 Beacon St. Charles Friedman and Abraham M. Heinowitz head the company.

**THE CHASE OIL ASSN., INC.**, Boston, Mass., has been incorporated with a capital of \$100,000 to manufacture petroleum products. The incorporators are John M. Chase, George A. Fisher, and Joseph Schmanska, 51 Allston Street.

**THE EDWARD E. ALLEN MFG. CO.**, Room 1016, 29 South La Salle St., Chicago, Ill., has been incorporated with a capital of \$50,000 to manufacture varnishes, enamels, paints, etc. The incorporators are Edward E. Allen and Louis A. Helle.

**THE SOUTHERN INK MFG. CO.**, Houston, Tex., has been incorporated with a capital of \$25,000 to manufacture ink and chemical specialties. The incorporators are R. T. McDonald, J. C. Lemons and J. C. Kegans, Houston.

**THE SYNTHETIC CHEMICAL CORPORATION**, Landsdowne, Baltimore Co., Md., has been incorporated with a capital of 500 shares of stock without par value to manufacture chemical products. The incorporators are D. List Warner, John S. Short and Leslie E. Mahn.

**THE H-W CHEMICAL CO.**, Columbia, S. C., has been incorporated with a capital of \$10,000 to manufacture chemicals and byproducts. The incorporators are J. S. Hammack and J. W. Wilson.

**THE JOLIET CARBONIC CO.**, 411 East Marion St., Joliet, Ill., has been incorporated with a capital of \$15,000 to manufacture acids, gases and byproducts. The incorporators are Walter F. and M. L. Pletcher, and Guy L. Meaker.

**THE HALOGEN PRODUCTS CO.**, New Bedford, Mass., has been incorporated with a

capital of \$10,000 to manufacture chemicals, drugs, etc. The incorporators are George Mazel, Peter Cairns and Thomas N. Roche, 279 County St.

**THE MAGNALOY METAL CORPORATION OF AMERICA**, 324 Bloomfield Ave., Montclair, N. J., has been incorporated with a capital of \$125,000 to manufacture metal alloys. The incorporators are Walter Lohry, Julius Kumpa and L. Friedmann.

**THE PENN DISTRIBUTING CO.**, Camden, N. J., has been incorporated with a capital of 2,000 shares of stock of no par value to manufacture and deal in alcohol and kindred products. The incorporators are Joseph P. Murray, Frank S. Muzzey and F. Stanley Saurman. The Corporation Trust Co., 328 Market St., is representative for the company.

**THE LA-LO CHEMICAL CO.**, Providence, R. I., has been incorporated with a capital of \$200,000 to manufacture chemicals and byproducts. The incorporators are E. J. Tetlow, C. E. Waterman and R. M. Greenlaw, Providence.

**THE FRANKLIN DEVELOPMENT CO.**, Benton, Ill., has been incorporated with a capital of \$35,000 to operate an oil refining plant. The incorporators are James Austin, Hosea Rea and A. G. Sisk, Benton.

**THE COLUMBIA PAINT CO.**, Columbia, S. C., has been incorporated with a capital of \$50,000 to manufacture paints, varnishes and affiliated products. The incorporators are W. J. Murray and A. S. Tompkins.

**THE SOUTH KENTUCKY OIL & GAS CO.**, Burkesville, Ky., has been incorporated with a capital of \$50,000 to manufacture petroleum products and operate a refining plant. The incorporators are James A. McGartlin, Burkesville; H. A. Walton and Olaf A. Urseth, both of St. Louis, Mo.

**THE UNITED SHALE BRICK CO.**, Ephrata, Pa., has been incorporated with a capital of \$100,000 to manufacture brick and other burned clay products. George W. Kinzer, Ephrata, is treasurer.

**THE RAJET CO.**, Boston, Mass., has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and byproducts. The incorporators are John K. Howard, Warren Matley and Dunbar F. Carpenter, 55 Congress St.

**THE WILLIAM H. SCHUTTE CO., INC.**, 419-21 South Wells St., Chicago, Ill., has been incorporated with a nominal capital of \$5,000 to manufacture oils, waxes, industrial alcohol and kindred products. The incorporators are William H. and B. I. Schutte, and John J. Kelly.

**THE NATIONAL CHEMICAL CORP.**, Stamford, Conn., has been incorporated with a capital of \$10,000 to manufacture chemicals and byproducts. The incorporators are P. J. Bowes, J. J. Roreck and A. S. Sorgi, 544 Main St.

**THE REFRACTORY PRODUCTS CO.**, Fredericksburg, Va., has been incorporated with a capital of \$900,000 to manufacture refractory specialties and insulation products. The incorporators are W. S. Quigley, L. E. Turk and T. M. Calvin. The company is affiliated with the Quigley Furnace Specialties Co., 26 Cortlandt St., New York.

**THE NATIONAL AGRICULTURAL CHEMICAL CO.**, Jersey City, N. J., has been incorporated with a capital of \$100,000 to manufacture fertilizer products, chemical derivatives, etc. The incorporators are Henry G. Feinberg, Benjamin Altman and P. C. Wilke. Charles H. Blohm, 286 Central Ave., is representative.

**THE ST. JOHN'S CHEMICAL CO.**, New York, has been incorporated with a capital of \$50,000 to manufacture chemicals and byproducts. The incorporators are A. E. and E. H. Post, and C. J. Hyland, 457 Third Ave., Brooklyn, N. Y.

**THE NORRIDGEWOCK LIME CO.**, Norridge-wock, Me., has been incorporated with a capital of \$200,000 to manufacture lime, operate limestone properties, etc. The incorporators are Charles H. Hussey, F. R. Folsom and Eben S. Miller.

**HAMMILL & GILLESPIE, INC.**, 240-42 Front St., New York, has been incorporated under Delaware laws with a capital of \$500,000 to operate clay properties, mine clay, etc. The incorporators are Hilliard M. Gillespie, William D. Hart and Frederick H. Stokes.

**THE DISOWAY CHEMICAL CO.**, Brooklyn, N. Y., has been incorporated with a capital of \$60,000 to manufacture chemicals and kindred products. The incorporators are E. J. Fenning, G. G. Dallan and T. N. Disoway, 412 E. 7th St.

**THE CHICAGO PORCELAIN CO.**, 1313 West Harrison St., Chicago, Ill., has been incor-

porated with a capital of \$10,000 to manufacture porcelain products. The incorporators are George T. Jennings, Gerald C. O'Brien and Leo N. Appar.

**THE RUMFORD PULP REDUCTION CO.**, Rumford, Me., has been incorporated with a capital of \$100,000 to manufacture pulp and paper products. The incorporators are Paul B. Hudson and George H. Murphy.

**THE BUR-MAC CHEMICAL CORP.**, New York, has been incorporated with a capital of \$50,000 to manufacture chemical and byproducts. The incorporators are W. R. and W. C. Burrows, and M. E. McGovern, 1 Liberty St.

**SAVELL & FROST, INC.**, Niagara Falls, N. Y., has been incorporated with a capital of \$150,000 to manufacture chemical products. The incorporators are A. Killian, J. G. G. Frost and W. L. Savell, Niagara Falls.

**GEORGE E. MIGNON, INC.**, New York, has been incorporated with a capital of \$50,000 to manufacture chemicals and byproducts. The incorporators are George E. Mignon, J. R. Clarke and R. T. Tyner, 49 Liberty St.

**THE CAZ CHEMICAL CORP.**, Atlanta, Ga., has been incorporated with a capital of \$100,000 to manufacture chemicals and byproducts. The incorporators are E. Saperstein, Frederick Darbonnier and Leon M. Shimoff, Atlanta.

## Coming Meetings and Events

**AMERICAN CERAMIC SOCIETY**, CHICAGO SECTION, plans to hold a joint meeting with the Illinois Clay Manufacturers Association of Chicago about March 8.

**AMERICAN CHEMICAL SOCIETY** will hold its sixty-first meeting at Rochester, N. Y., April 26 to 29.

**AMERICAN ELECTROCHEMICAL SOCIETY** will hold its spring meeting at Atlantic City April 21 to 23 inclusive. Headquarters will be at the Hotel Chalfonte.

**AMERICAN INSTITUTE OF CHEMICAL ENGINEERS** will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

**AMERICAN OIL CHEMISTS' SOCIETY** (formerly the Society of Cotton Products Analysts) will hold its twelfth annual meeting in Chicago May 16 and 17.

**AMERICAN PAPER & PULP ASSOCIATION** will hold its annual meeting at the Waldorf-Astoria and Hotel Astor, New York City, April 11 to 15.

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS** will hold its spring meeting at the Congress Hotel, Chicago, May 23 to 26.

**AMERICAN SOCIETY FOR TESTING MATERIALS** will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20.

**CANADIAN INSTITUTE OF MINING AND METALLURGY** will hold its annual general meeting in the Chateau Laurier, Ottawa, Ont., on March 2, 3 and 4.

**CHAMBER OF COMMERCE OF THE UNITED STATES** will hold its ninth annual meeting in Atlantic City April 27, 28 and 29.

**NATIONAL PETROLEUM CONGRESS** will meet at the Hotel Baltimore, Kansas City, Mo., March 22 to 25.

**NATIONAL SAFETY COUNCIL, ENGINEERING SECTION**, will hold its midwinter meeting in Philadelphia Feb. 28.

**NEW JERSEY CHEMICAL SOCIETY** holds a meeting at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

**SOCIETY OF INDUSTRIAL ENGINEERS** will hold a meeting in Milwaukee April 27, 28 and 29.

**THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH)** will be held during the week of Sept. 12, in the Eighth Coast Artillery Armory, New York City.

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: March 11, American Chemical Society; March 25, Society of Chemical Industry; April 22, Society of Chemical Industry, joint meeting with American Electrochemical Society, Société de Chimie Industrielle and American Chemical Society; May 6, American Chemical Society, Nichols Medal award; May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.